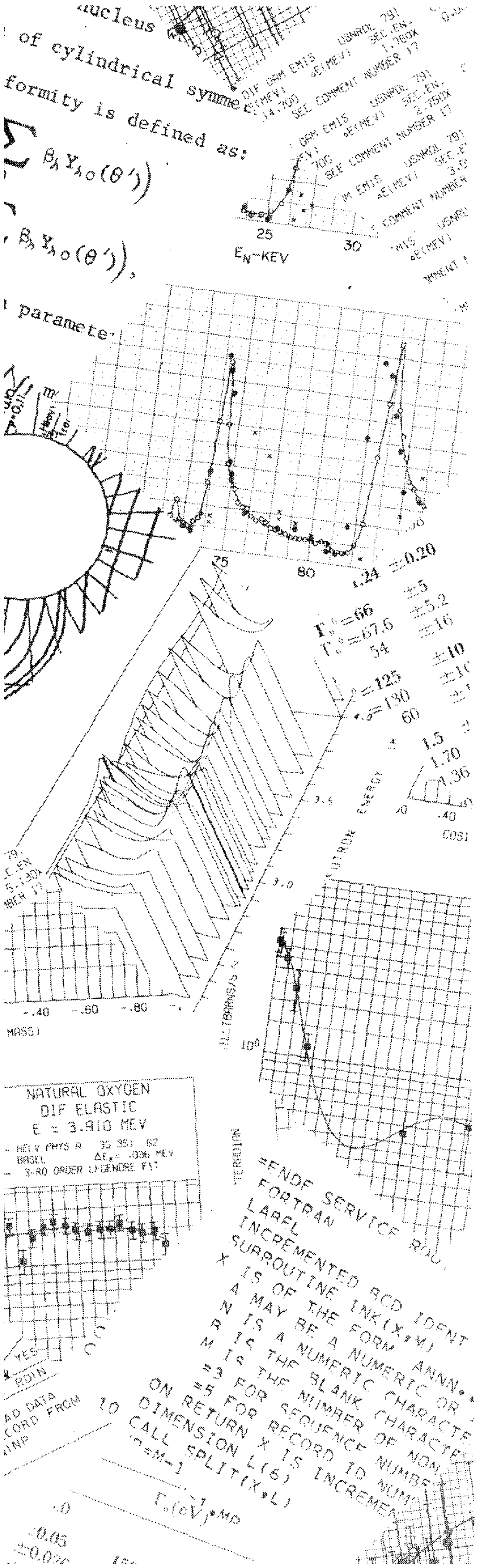


BNL-NCS-50446
(ENDF-216)
NEACRP-L-145
NEANDC(US)-193/L
INDC(US)-70/L

ENDF/B-IV DOSIMETRY FILE

Edited by
B.A. MAGURNO

April 1975

INFORMATION ANALYSIS CENTER REPORT

NATIONAL NEUTRON CROSS SECTION CENTER
BROOKHAVEN NATIONAL LABORATORY
UPTON, NEW YORK 11973

National
Neutron
Cross
Section
Center

BNL-NCS-50446
(ENDF-216)
(Physics-Nuclear - TID-4500)

ENDF/B-IV DOSIMETRY FILE

Edited by
B.A. MAGURNO

April 1975

NATIONAL NEUTRON CROSS SECTION CENTER

BROOKHAVEN NATIONAL LABORATORY
ASSOCIATED UNIVERSITIES, INC.
UNDER CONTRACT NO. E(30-1)-16 WITH THE
U.S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

Printed in the United States of America
Available from
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161
Price: Printed Copy, Domestic $8.75;
Foreign $11.25; Microfische $1.45

August 1975 800 copies

GUIDE TO CONTENTS

INTRODUCTION

The Dosimetry File [1] issued as part of the ENDF/B-IV Library contains thirty-six reactions in twenty-six isotopes. Each isotope in the ENDF/B-IV Library starts with a brief description of the data and methods used in that particular evaluation (File 1). The purpose of this report is to present, where feasible, a more detailed description, summarizing those evaluations that appear on the Dosimetry File.

The Dosimetry File evolved as a consequence of the Task Force assembled at Battelle Northwest by the Normalization and Standards Subcommittee of the Cross Section Evaluation Working Group (CSEWG) to review the cross section sets used for dosimetry purposes in the Inter-laboratory LMFBR Reaction Rate (ILRR) Program. From the list of necessary dosimetry materials prepared by the Task Force, all reactions already included in the ENDF/B General Purpose Library (with subsequent updating) were to be extracted and placed on the Dosimetry File. All other reactions on the list were assigned to Task Force members for evaluation. The "Table of Contents" of this volume lists all the reactions from the Task Force list, name and affiliation of the authors of each evaluation, the particular reaction assigned, and the Material (MAT) Number.

There are several different types of entries in the ensuing pages:

Documentation for threshold reactions (other than fission), which were evaluated by Task Force Members and whose Atomic Number $Z \leq 90$, contains a description of the evaluation by the authors, references used, and a series of graphs displaying the experimental data and the evaluated curve in discrete energy regions. Immediately following each evaluation is a reproduction of the data file as it appears on the Dosimetry File and a single curve over the entire energy region plotted from the evaluation on the Dosimetry File.

Documentation for threshold reactions, which were taken from the ENDF/B-IV General Purpose Library and whose $Z \leq 90$, contains an extracted portion of the Summary Documentation [2] (found in ENDF-201), and the original report is identified. These reactions are followed (as above) with a reproduction of the data on the Dosimetry File and a single plot of the reaction over the entire energy range.

Documentation for exoergic reactions, which were evaluated by Task Force members and whose $Z \leq 90$, contains a description of the evaluations by the authors and the references used. Following each evaluation is a reproduction of the data on the Dosimetry File and a plot of the data. For convenience, experimental data from the CSISRS+ Library outside of the resolved resonance energy region is plotted on the curve. The references for the experimental data sets are included.

Documentation for exoergic reactions (including Threshold Fission), which were taken from the ENDF/B-IV General Purpose Library and whose $Z \leq 90$ contains an extracted portion of the Summary Documentation(2) (ENDF-201), and the original report is identified. These reactions are followed by a reproduction of the data on the Dosimetry File, a single plot of the reaction and the experimental data (outside of the Resolved Resonance Energy Region) and the references from CSISRS.

Documentation for reactions whose $Z > 90$ was considered too complex (e.g. the relationship between σ_f, σ_c and $\bar{\nu}$) to extract. Since all reactions with $Z > 90$ are from the ENDF/B-IV General Purpose Library, the reader in need of detailed information is directed to ENDF-201(2). In place of summary documentation, File 1 from the ENDF/B-IV General Purpose Library is included here. As in the cases above, a reproduction of the data from the Dosimetry File, a plot of the data, experimental points outside the resolved energy region, and references for the experimental data are included.

In the case of ^{235}U(n,f), the portion of the curve from ~10 keV-20 MeV is enlarged and included as a separate page.

Because of extenuating circumstances, not all the reactions included here were renormalized to ENDF/B-IV. Those that were not are identified with ENDF/B-III in the Documentation Titles. The reactions include:
^{32}S(n,p), ^{54}Fe(n,p), ^{56}Fe(n,p), ^{115}In(n,n'), ^{58}Ni(n,p).

+ Cross Section Information Storage & Retrieval System (CSISRS) Maintained at the National Neutron Cross Section Center.

Appendix I contains a table of derived parameters, i.e. the Resonance Integral of the exoergic reactions and the ^{235}U Fission Spectrum Average Cross Sections (T = 1.32) of all reactions on the file.

For additional information concerning the evaluated files, as well as corresponding experimental data, contact:

National Neutron Cross Section Center
Brookhaven National Laboratory
Upton, New York 11973

[1] ENDF/B-IV Dosimetry File; Tape 412, issued January 1975

[2] ENDF/B Summary Documentation ENDF-201 - BNL 17541, June 1975

Acknowledgements

In projects of this nature, the support and encouragement of the individual authors over and above the initial contributions of their manuscripts is necessary and even critical in order to produce a final product. My thanks are extended to all. Special mention is due to L. Stewart of Los Alamos Scientific Laboratory for her efforts in proofreading and criticism of the manuscripts.

Thanks are also extended to all the BNL personnel involved; particularly R. Kinsey of the National Neutron Cross Section Center for directing and C. Brewster and A. Fuoco for producing the graphic portions of this report, and to the Photography and Graphic Arts Division for production of the final pages.

Finally, I wish to recognize and acknowledge the unflagging interest and encouragement shown this project by both P. Hemmig of the U.S. Energy Research Division Administration and S. Pearlstein of the National Neutron Cross Section Center.

TABLE OF CONTENTS

TABLE OF CONTENTS

*Present Address: U. S. Energy Research Development Administration, Washington D.C. 20045

**Present Address: Brookhaven National Laboratory, Upton, New York 11973

$^{+}$ENDF/B Summary Documentation - ENDF-201 BNL 17541, June 1975

Total Helium Production Cross Section for Neutron-Induced Reactions on ^{6}Li for ENDF/B-IV

L. Stewart and G.M. Hale

Los Alamos Scientific Laboratory

Theoretical Division - January 1975

Below 10 MeV, the following reactions produce alpha particles from neutron interactions with ^{6}Li:

Reaction	Q (MeV)	Threshold (MeV)
$^{6}Li(n,t)\alpha$	+4.785	-
$^{6}Li(n,n'd)\alpha$	-1.472	1.717
$^{6}Li(n,2np)\alpha$	-3.697	4.313

In the alpha-production data that were provided for the Version IV dosimetry file only the $^{6}Li(n,t)\alpha$ contribution differs from the Version III dosimetry file. The (n,t) data below 2 MeV are based on the coupled-channel R-matrix analysis by Hale, Dodder, Young, and Stewart that were included in the general purpose Version IV file. The analysis included experimental data for the total and the (n,t) cross sections and various differential cross section measurements for n + ^{6}Li and α + t elastic scattering, as described in the File 1 comments of the Version IV data.

The (n,n'd) and (n,2np) cross sections are the same as were provided for the Version III dosimetry files and are based on smooth curves through the available experimental data. These data are compared with the Version III evaluation and with experimental data in Figs. 1 and 2. Note that the dosimetry data for the (n,n'd) and (n,2np) reactions are lower and higher, respectively, than the Version III evaluation. This remark also applies for the Version IV evaluation, which is the same as Version III for the (n,n'd) and (n,2np) reactions.

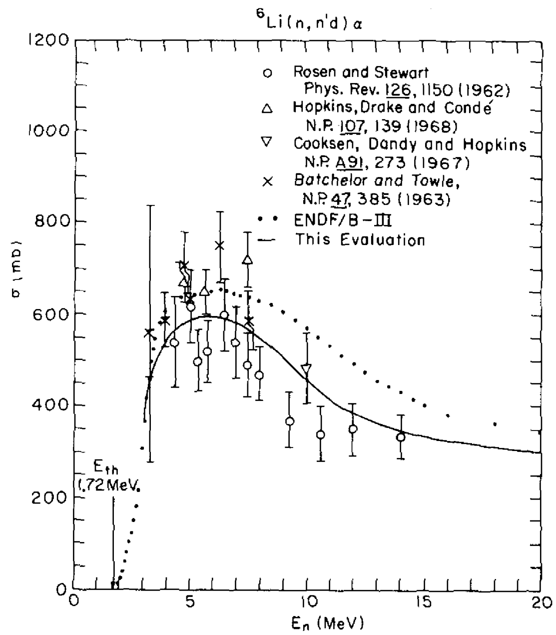


Figure 1

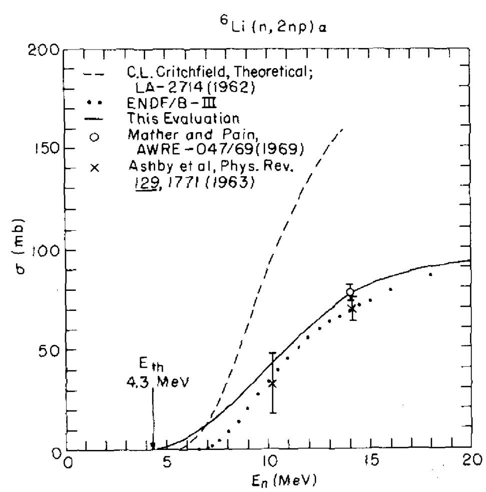


Figure 2

3-LI- 6 LASL EVAL-NOV73 HALE,NISLEY AND YOUNG
DIST-1974

ACCEPTED FOR DOS, FILE BY NORMALIZATION AND STANDARDS SUBCOMMITTEE 12/73.SUPPLIED BY P.G.YOUNG LASL

DATA TABLE BELOW IS THE TOTAL HELIUM PRODUCTION CROSS SECTION OF LI-6, FOR CONVENIENCE IT IS LISTED AS MT=107.THE CROSS SECTION IS COMPOSED OF THREE REACTIONS I.E.

LI-6(N,T)ALPHA
LI-6(N,NPRIME D)ALPHA
LI-6(N,2NP)ALPHA

PERTINENT HOLLORITH FROM GENERAL FILE FOLLOWS.(MAT 1271)

TOTAL,ELASTIC,AND (N,ALPHA) CROSS SECTIONS AND ELASTIC ANGULAR DISTRIBUTIONS REPLACED FOR NEUTRON ENERGIES BELOW 1.2 MEV BY HALE,DODDER,YOUNG AND STEWART AT LASL JAN 74

THE NEW DATA RESULT FROM A COUPLED-CHANNEL R,MATRIX ANALYSIS THAT IS DESCRIBED IN THE GENERAL FILE.

(N-ALPHA)MT=107 SIGMA=940.00 BARNS

RES,PAR, MF=2 MT=151 SCATTERING RADIUS ONLY.

SMOOTH CROSS SECTION MF=3 MT=107(IE N,T ALPHA ONLY)

BELOW 1.2 MEV BASED ON R=MATRIX ANALYSIS DESCRIBED UNDER MT=1 ALTHOUGH THE DATA OF REF 13 WERE NOT EXPLICITLY INCLUDED IN THE ANALYSIS,THESE DATA ARE GENERALLY CONSISTANT WITH THE RESULTS OF REF 14 AND 15 WHICH WERE INCLUDED.IN ADDITION THE EVALUATED (N,ALPHA) CROSS SECTION AGREES WELL WITH THE VERSION IV EVALUATION OF B-10(N,ALPHA)CROSS SECTION AND THE RATIO MEASUREMENT OF REF.18.THE (N,ALPHA) BETWEEN 2 AND 15 MEV IS BASED ON REF.1.EXTRAPOLATION TO 20 MEV IS BASED ON KERN AND KREGER DATA (REF.8)BETWEEN 15 AND 18 MEV.

REFERENCES

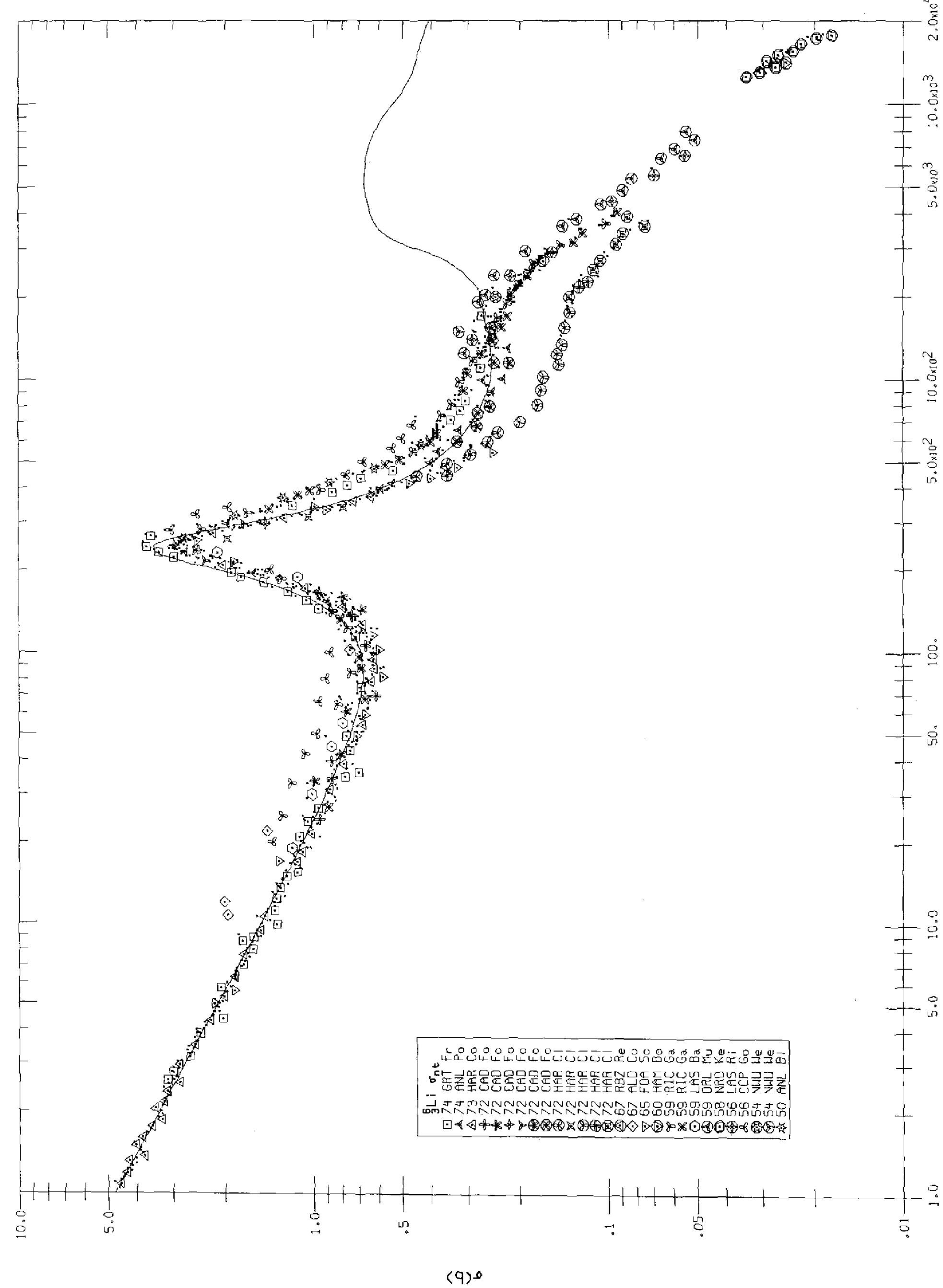
1. PENDLEBURY, E.D., REPORT AWRE O=60/64.
2. DIMENT, K.M., AND UTTLEY, C.A., NUCLEAR PHYSICS DIVISION PROGRESS REPORTS AERE-PR/NP 15 AND AERE-PR/NP 16 (1969). ALSO PRIVATE COMMUNICATION FROM C. A. UTTLEY TO LEONA STEWART.
3. HIBDON, C.T., AND MOORING, F.P., CONFERENCE ON NEUTRON C/S TECHNOLOGY, WASH., D.C., 1, 159 (1968).
4. FOSTER, D.G.,JR., AND GLASGOW, D.W., HW-73116 AND HW-77311.
5. PETERSON, J.M., ET AL, PHYS REV 120, 521 (1960).
6. HOPKINS, J.C., ET AL, LOS ALAMOS SCI LAB REPORT LA-3765 (1967).
7. PRESSER, G., ET AL, NUCL PHYS A131, 679 (1969).
8. KERN, B.D., AND KREGER, W.E., PHYS REV 112, 926 (1958).
9. LANE, R.O., ET AL, ANN PHYS 12, 135(1961).
10. L. ROSEN AND L. STEWART, LA-2643.
11. F. AJZENBERG-SELOVE AND T.LAURITZEN, ENERGY LEVELS OF LIGHT NUCLEI, TO BE PUBLISHED.
12. J.W.MEADOWS AND J.F.WHALEN, NUCL.SCI.ENGR. 41,351 (1970).
13. E.FORT AND J.P.MARQUETTE, PRIVATE COMMUNICATION TO L.STEWART, (1973).
14. M.S.COATES, G.J.HUNT, AND C.A.UTTLEY, PRIVATE COMMUNICATION TO L.STEWART, (1973).
15. W.P.POENITZ, PRIVATE COMMUNICATION TO L.STEWART, (1973).
16. A.ASAMI AND M.C.MOXON, NUCL.DATA FOR REACTORS, HELSINKI, 1970, P153.
17. R.J.SPIGER AND T.A.TOMBRELLO, PHYS.REV. 163, 964 (1970).
18. M.G.SOWERBY ET AL., J.NUCL.ENERGY 24, 323 (1970).
19. E.T.JURNEY, LASL, PRIVATE COMMUNICATION, (1973).

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION	RANGE	DESCRIPTION
1 TO 24	LN Y LINEAR IN LN X	24 TO 177	Y LINEAR IN X

NEUTRON CROSS SECTIONS

INDEX,	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	1.0000E-05	4.7284E+04	1.0000E-02	1.4952E+03	2.5300E-02	9.4003E+02	1.0000E-01	4.7282E+02	1.0000E+00	1.4951E+02
6	1.0000E+01	4.7266E+01	1.0000E+02	1.4936E+01	4.0000E+02	7.4631E+00	1.0000E+03	4.7188E+00	2.0000E+03	3.3380E+00
11	4.0000E+03	2.3647E+00	6.5000E+03	1.8610E+00	1.0000E+04	1.5085E+00	1.5000E+04	1.2429E+00	2.0000E+04	1.0875E+00
16	2.5000E+04	9.8389E-01	3.0000E+04	9.0949E-01	3.5000E+04	8.5359E-01	4.0000E+04	8.1036E-01	4.5000E+04	7.7634E-01
21	5.0000E+04	7.4934E-01	6.0000E+04	7.1104E-01	7.0000E+04	6.8849E-01	8.0000E+04	6.7831E-01	9.0000E+04	6.7901E-01
26	1.0000E+05	6.9028E-01	1.1000E+05	7.1274E-01	1.2000E+05	7.4791E-01	1.3000E+05	7.9831E-01	1.4000E+05	8.6768E-01
31	1.5000E+05	9.6140E-01	1.6000E+05	1.0870E+00	1.7000E+05	1.2545E+00	1.8000E+05	1.4767E+00	1.9000E+05	1.7676E+00
36	2.0000E+05	2.1366E+00	2.0500E+05	2.3487E+00	2.1000E+05	2.5740E+00	2.1500E+05	2.8041E+00	2.1600E+05	2.8497E+00
41	2.1700E+05	2.8949E+00	2.1800E+05	2.9396E+00	2.1900E+05	2.9835E+00	2.2000E+05	3.0267E+00	2.2100E+05	3.0690E+00
46	2.2200E+05	3.1101E+00	2.2300E+05	3.1501E+00	2.2400E+05	3.1886E+00	2.2500E+05	3.2256E+00	2.2600E+05	3.2610E+00
51	2.2700E+05	3.2945E+00	2.2800E+05	3.3261E+00	2.2900E+05	3.3556E+00	2.3000E+05	3.3829E+00	2.3100E+05	3.4079E+00
56	2.3200E+05	3.4304E+00	2.3300E+05	3.4504E+00	2.3400E+05	3.4677E+00	2.3500E+05	3.4823E+00	2.3600E+05	3.4941E+00
61	2.3700E+05	3.5031E+00	2.3800E+05	3.5093E+00	2.3900E+05	3.5126E+00	2.4000E+05	3.5130E+00	2.4100E+05	3.5105E+00
66	2.4200E+05	3.5052E+00	2.4300E+05	3.4971E+00	2.4400E+05	3.4863E+00	2.4500E+05	3.4728E+00	2.4600E+05	3.4567E+00
71	2.4700E+05	3.4382E+00	2.4800E+05	3.4172E+00	2.4900E+05	3.3940E+00	2.5000E+05	3.3686E+00	2.5100E+05	3.3412E+00
76	2.5200E+05	3.3120E+00	2.5300E+05	3.2809E+00	2.5400E+05	3.2483E+00	2.5500E+05	3.2141E+00	2.5600E+05	3.1786E+00
81	2.5700E+05	3.1419E+00	2.5800E+05	3.1041E+00	2.5900E+05	3.0654E+00	2.6000E+05	3.0258E+00	2.6100E+05	2.9856E+00
86	2.6200E+05	2.9448E+00	2.6300E+05	2.9035E+00	2.6400E+05	2.8619E+00	2.6500E+05	2.8200E+00	2.6600E+05	2.7779E+00
91	2.6700E+05	2.7358E+00	2.6800E+05	2.6937E+00	2.6900E+05	2.6517E+00	2.7000E+05	2.6098E+00	2.7500E+05	2.4051E+00
96	2.8000E+05	2.2119E+00	2.8500E+05	2.0335E+00	2.9000E+05	1.8713E+00	2.9500E+05	1.7252E+00	3.0000E+05	1.5945E+00
101	3.0500E+05	1.4779E+00	3.1000E+05	1.3740E+00	3.2000E+05	1.1991E+00	3.4000E+05	9.4784E-01	3.6000E+05	7.8239E-01
106	3.8000E+05	6.6872E-01	4.0000E+05	5.8745E-01	4.2500E+05	5.1470E-01	4.5000E+05	4.6246E-01	4.7500E+05	4.2353E-01
111	5.0000E+05	3.9362E-01	5.5000E+05	3.5113E-01	6.0000E+05	3.2279E-01	6.5000E+05	3.0284E-01	7.0000E+05	2.8824E-01
116	8.0000E+05	2.6886E-01	9.0000E+05	2.5732E-01	1.0000E+06	2.5046E-01	1.1000E+06	2.4676E-01	1.2000E+06	2.4547E-01
121	1.3000E+06	2.4624E-01	1.4000E+06	2.4896E-01	1.5000E+06	2.5364E-01	1.6000E+06	2.6000E-01	1.7000E+06	2.6400E-01
126	1.7180E+06	2.6307E-01	1.8000E+06	2.6500E-01	1.9000E+06	2.6400E-01	2.0000E+06	2.6600E-01	2.1000E+06	2.7200E-01
131	2.2000E+06	2.8200E-01	2.3000E+06	2.9300E-01	2.4000E+06	3.0500E-01	2.5000E+06	3.1500E-01	2.6000E+06	3.3600E-01
136	2.7000E+06	3.5300E-01	2.8000E+06	3.7600E-01	3.0000E+06	4.5300E-01	3.1000E+06	4.9800E-01	3.1920E+06	5.2900E-01
141	3.3000E+06	5.5900E-01	3.4000E+06	5.8000E-01	3.5000E+06	5.9700E-01	3.6000E+06	6.1000E-01	3.8000E+06	6.2900E-01
146	4.0000E+06	6.4100E-01	4.1580E+06	6.4800E-01	4.2000E+06	6.5000E-01	4.4000E+06	6.5665E-01	4.7000E+06	6.6430E-01
151	5.0000E+06	6.6962E-01	5.3000E+06	6.7370E-01	5.6000E+06	6.7200E-01	6.0000E+06	6.7000E-01	6.4000E+06	6.6330E-01
156	6.6140E+06	6.5852E-01	7.0000E+06	6.4950E-01	7.2000E+06	6.4450E-01	7.6000E+06	6.3150E-01	8.0000E+06	6.1800E-01
161	8.5000E+06	5.9900E-01	9.0000E+06	5.7900E-01	9.5000E+06	5.5600E-01	1.0000E+07	5.3620E-01	1.0500E+07	5.1730E-01
166	1.1000E+07	5.0120E-01	1.1500E+07	4.8820E-01	1.2000E+07	4.7780E-01	1.2500E+07	4.6880E-01	1.3000E+07	4.6230E-01
171	1.3500E+07	4.5650E-01	1.4000E+07	4.5150E-01	1.4500E+07	4.4750E-01	1.5000E+07	4.4280E-01	1.6000E+07	4.3600E-01
176	1.8000E+07	4.2100E-01	2.0000E+07	4.0800E-01						



REFERENCES FOR EXPERIMENTAL DATA

^{6}Li(n,t)

Yr.	Lab	Author	References
74	GRT	Friesenhahn, et al.	INTEL-RT-7011 (1974)
74	ANL	Poenitz	Priv. Comm. (1974)
73	HAR	Coates	Priv. Comm. (1973)
72	CAD	Fort, et al.	EANDC-(E)-148 (1972)
72	HAR	Clements, et al.	AERE-R-7075 (1972)
67	RBZ	Rendic, et al.	ZFK-130, 143 (1967)
67	ALD	Cox, et al.	J. Nuc. En. 21, 271 (1967)
66	ALD	Barry	Conf. Neutron Cross Sections and Tech., Washington D.S. Vol II, 763 (1966)
65	FOA	Condé, et al.	Ark. Fiz. 29, 45 (1965)
65	FOA	Schwartz, et al.	Nuc. Phys. 63, 593 (1965)
61	CCP	Mikailina, et al.	Sov. Prog. Nuc. Phys. p.185 (1961)
60	HAM	Bormann, et al.	Zeit. Nat. /A 15, 200 (1960)
60	CCP	Perelygin, et al.	At. En. 9, 488 (1960)
59	NWU	Pardo, et al.	Bull. Am. Phys. Soc. 4, 218 (1959)
59	RIC	Gabbard, et al.	Phys. Rev. 114, 201 (1959)
59	LAS	Bame, et al.	Phys. Rev. 114, 1580 (1959)
59	ORL	Murray, et al.	Phys. Rev. 115, 1707 (1959)
58	NRD	Kern, et al.	Phys. Rev. 112, 926 (1958)
57	CCP	Elpidinskii, et al.	At. En./Supp 5, 75 (1957)
56	LAS	Ribe	Phys. Rev. 103, 741 (1956)
56	CCP	Gorlov, et al.	Dok. 111, 791 (1956)
54	LAS	Frye, Jr.	Phys. Rev. 93, 1086 (1954)
54	NWU	Weddell, et al.	Phys. Rev. 95, 117 (1954)
52	LAS	Ribe	Phys. Rev. 87, 205 (1952)
50	ANL	Blair, et al.	ANL-4515, 7 (1950)

Total Helium Production Cross Section From n + ^{10}B

Interactions for ENDF/B-IV

P.G. Young and G.M. Hale

Los Alamos Scientific Laboratory

Theoretical Division - January 1975

Below 10 MeV, the following reactions produce helium from neutron interactions in ^{10}B:

	Reaction	Q (masses) MeV	Laboratory Threshold (MeV)
(1)	$^{10}B(n,\alpha_o)^7Li$	+2.792	-
(2)	$^{10}B(n,\alpha_1)^7Li^*$(478 keV)	+2.314	-
(3)	$^{10}B(n,n'\alpha)^6Li$	-4.461	4.907
(4)	$^{10}B(n,t2\alpha)$	+0.324	-
(5)	$^{10}B(n,n'd2\alpha)$	-5.933	6.526
(6)	$^{10}B(n,2np2\alpha)$	-8.158	8.974

The total helium production cross section was derived by summing the cross sections from reactions (1)-(3) plus twice the sums of reactions (4)-(6). The data for reactions (1), (2), and (4) were taken directly from the Version IV evaluation. Below 1 MeV reactions (1) and (2) are based on a coupled-channel R-matrix analysis,[1] and reaction (4) on a single-channel analysis. The experimental data included in the analyses are referenced in the File 1 comments of the Version IV evaluation. Above 1 MeV, reac-

1. G.M. Hale, P.G. Young, and R.A. Nisley, "R-Matrix Analysis of the n + ^{10}B System at Low Energies," Trans. Am. Nucl. Soc. 18, 327 (1974).

tions (1), (2), and (4) are based on smooth curves through experimental data, as outlined in the File 1 comments.

The contributions from reactions (3) and (5) were also obtained from the Version IV evaluation by summing the appropriate discrete (n,n') cross sections to particle unstable final states, as indicated by LR flags. Reaction (6), which was not included in the Version IV evaluation because of its small magnitude, was estimated from the measurements of Mather[2] at 14 MeV.

2. D.S. Mather and L.F. Pain, "Measurement of (n,2n) and (n,3n) Cross Sections at 14 MeV Incident Energy," AWRE report 047/69 (1969).

```
  5-B - 10 LASL        EVAL-NOV73 HALE,NISLEY AND YOUNG
                       DIST 1974
     ACCEPTED FOR DOS, FILE BY NORMALIZATION AND STANDARDS
         SUBCOMITTEE 12/73, SUPPLIED BY P.G.YOUNG LASL
     PERTINENT HOLLORITH FROM GENERAL FILE FOLLOWS.(MAT 1273)
MF=2 ---------- RESONANCE PARAMETERS --------------------------------
  MT=151  EFFECTIVE SCATTERING RADIUS = Ø.4Ø937E-12 CM
MF=3 ---------- SMOOTH CROSS SECTION--------------------------------
     THE 22ØØ M/S CROSS SECTION ARE AS FOLLOWS,
         MT=1Ø7  SIGMA =3836.5   BARNS
         MT=113  SIGMA =Ø.ØØØ566 BARNS
         MT=78Ø  SIGMA =24Ø.51   BARNS
         MT=781  SIGMA =3596.Ø   BARNS
  MT=1Ø7   (N,ALPHA) CROSS SECTION  (GENERAL FILE  ONLY)
     Ø TO 2Ø MEV, SUM OF MT=78Ø,781
  MT=113   (N,T2ALPHA) CROSS SECTION
     Ø TO 2.3 MEV,BASED ON A SINGLE-LEVEL FIT TO RESONANCE
         MEASURED AT 2 MEV BY DA61,ASSUMING L=Ø INCOMING NEUTRONS
         AND L=2 OUTGOING TRITONS.
     2.3 TO 2Ø MEV, SMOOTH CURVE THROUGH MEASUREMENTS OF FR56
         AND WY58,FOLLOWING GENERAL SHAPE OF DA 61 MEASUREMENT
         FROM 4 TO 9 MEV.
  MT=78Ø   (N,ALPHAØ)CROSS SECTION
     Ø TO 1 MEV,CALCULATED FROM THE R-MATRIX PARAMETERS
         DESCRIBED FOR MT=1.EXPERIMENTAL (N,ALPHAØ) DATA INPUT
         TO THE FIT WERE THOSE OF MA68 AND DA61, IN ADDITION,THE
         ANGULAR DISTRIBUTIONS OF VA72 FOR THE INVERSE REACTION
         WERE INCLUDED IN THE ANALYSIS.
     1 TO 2Ø MEV, BASED ON DA61 MEASUREMENTS,WITH SMOOTH EXTRA-
         POLATION FROM 8 TO 2Ø MEV, DA61 MEASUREMENT ABOVE
         APPROXIMATELY 2 MEV WAS RENORMALIZED BY FACTOR OF 1.4.
  MT=781   (N,ALPHA1) CROSS SECTION
     Ø TO 1 MEV, CALCULATED FROM THE R-MATRIX PARAMETERS
     DESCRIBED FOR MT=1,EXPERIMENTAL (N,ALPHA1) DATA INCLUDED
          IN THE FIT ARE THOSE OF FR72.
     1 TO 2Ø MEV, SMOOTH CURVE THROUGH MEASUREMENTS OF DA61 AND
         NE7Ø, WITH SMOOTH EXTRAPOLATION FROM 15 TO 2Ø MEV, THE
         DA61 DATA ABOVE APPROXIMATELY 2 MEV WERE RENORMALIZED
         BY A FACTOR OF 1.4.
     DATA TABLE BELOW IS THE TOTAL HELIUM PRODUCTION CROSS
         SECTION OF B-1Ø, FOR CONVENIENCE IT IS LISTED AS
         MT=1Ø7.THE CROSS SECTION IS COMPOSED OF SIX REACTIONS,
         I.E.
             B-1Ø(N,ALPHAØ)LI-7              MT=78Ø
             B-1Ø(N,ALPHA1)LI-7*(478 KEV)    MT=781
             B-1Ø(N,NPRIME ALPHA)LI-6        MT=113
         AND TWICE THE SUM OF
             B-1Ø(N,T2ALPHA)
             B-1Ø(N,NPRIME D 2ALPHA)
             B-1Ø(N,2NP2ALPHA)
```

REFERENCES

AL66 D.E. ALBURGER ET AL.,PHYS.REV. 143,692 (1966)

AS70 A. ASAMI AND M.C. MOXON, J.NUCL.ENERGY 24,85 (1970)

BA60 R.BARDES AND G.E. OWEN. PHYS.REV.120,1369 (1960)

BE56 R.L. BECKER AND H.H. BARSCHALL, PHYS.REV.102,1384(1956)

BI57 H.BICHSEL AND T.W.BONNER,PHYS.REV.108,1025 (1957)

BO51 C.K.BOCKELMAN ET AL., PHYS.REV. 84,69 (1951)

BO69 D.BOGART AND L.L.NICHOLS, NUCL.PHYS.A125,463 (1969)

CO52 J.H.COON ET AL., PHYS.REV. 88,562 (1952)

CO54 C.F.COOK AND T.W. BONNER,PHYS.REV. 94,651 (1954)

CO67 S.A. COX AND F.R. PONTET. J.NUCL.ENERGY 21,271 (1967)

CO69 J.A. COOKSON AND J.G.LOCKE,NUCL.PHYS.A146,417(1970)

CO73 M.S. COATES ET AL., PRIV. COMM. TO L.STEWART (1973)

CU65 R.Y.CUSSON, THESIS, CALIF. INSTIT. TECH. (1965)

DA56 R.B.DAY,PHYS.REV.102,767 (1956)

DA60 R.B. DAY AND M.WALT,PHYS.REV.117,1330 (1960)

DA61 E.A. DAVIS ET AL., NUCL.PHYS.27,448 (1961)

DI67 K.M. DIMENT, AERE-R-5224 (1967)

FO61 D.M. FOSSAN ET AL., PHYS.REV. 123,209 (1961)

FR56 G.M. FRYE AND J.H. GAMMEL,PHYS.REV. 103,328 (1956)

FR72 S.J. FRIESENHAHN ET AL., GULF-RT-A12210 (1972)

HA73 S.L.HAUSLADEN, THESIS, OHIO UNIV. COO-1717-5 (1973)

HO69 J.C. HOPKINS, PRIV. COMM. LASL (1969)

IR67 D.C.IRVING, ORNL-TM-1872 (1967)

LA66 T.LAURITSEN AND F.AJZENBERG-SELOVE,NUCL.PHYS.78,1(1966)

LA71 R.O. LANE ET AL., PHYS.REV.C4,380 (1971)

MA68 R.L.MACKLIN AND J.H.GIBBONS,PHYS.REV.165,1147 (1968)

MO66 F.P.MOORING ET AL.,NUCL.PHYS.82,16 (1966)

NE54 N.G.NERESON,LA-1655 (1954)

NE70 D.C.NELLIS ET AL., PHYS.REV. C1,847 (1970)

PO70 D.PORTER ET AL., AWRE O 45/70 (1970)

SE66A R.E. SEGEL AND R.H. SIEMSSEN,PHYS.LETT.20,295 (1966)

SE66B R.E.SEGEL ET AL., PHYS.REV. 145,736(1966)

SI65 R.H.SIEMSSEN ET AL., NUCL.PHYS.69,209 (1965)

TE62 K.TESCH, NUCL.PHYS.37,412 (1962)

TS63 K.TSUKADA AND O.TANAKA.J.PHYS.SOC.JAPAN 18,610 (1963)

VA65 V.VALKOVIC ET AL., PHYS.REV. 139,331 (1965)

VA70 B.VAUCHER ET AL.,HELV.PHYS.ACTA 43,237 (1970)

VA72 L.VAN DER ZWAN AND K.W.GEIGER,NUCL.PHYS.A180,615(1972)

WI55 H.B. WILLARD ET AL., PHYS.REV. 98,669 (1955)

WY58 M.E. WYMAN ET AL., PHYS.REV.112,1264 (1958)

REFERENCES FOR EXPERIMENTAL DATA

$^{10}B(n,\alpha)$

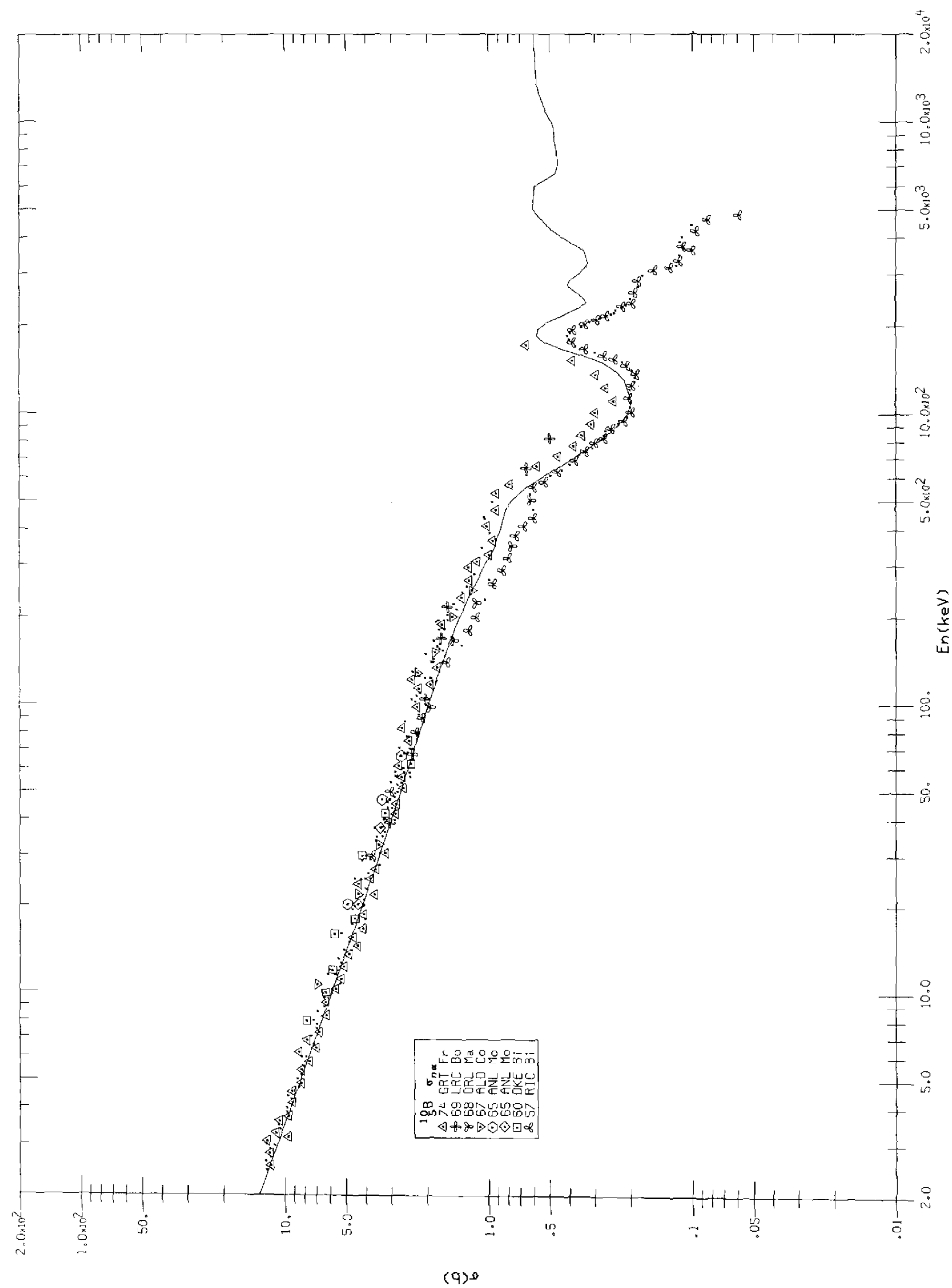
Yr.	Lab	Author	References
74	GRT	Friesenhahn, et al.	INTEL-AT-7011 (1974)
69	LRC	Bogart, et al.	Nuc. Phys./A 125, 463 (1969)
68	ORL	Macklin, et al.	Phys. Rev. 165, 1147 (1968)
67	ALD	Cox, et al.	J. Nuc. En. 21, 271 (1967)
65	ANL	Mooring, et al.	ANL-6877 (1965)
60	DKE	Bilpuch, et al.	An. Phys. 10, 455 (1960)
57	RIC	Bichsel, et al.	Phys. Rev. 108, 1025 (1957)

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION
1 TO 96	LN Y LINEAR IN LN X
96 TO 193	Y LINEAR IN X

NEUTRON CROSS SECTIONS

INDEX.	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	1.0000E-05	1.9300E+05	2.5300E-02	3.8365E+03	1.0000E-01	1.9294E+03	1.0000E+00	6.0989E+02	1.0000E+01	1.9260E+02
6	1.0000E+02	6.0644E+01	1.0000E+03	1.8958E+01	5.0000E+03	8.3639E+00	1.0000E+04	5.8871E+00	2.0000E+04	4.1655E+00
11	3.0000E+04	3.4190E+00	4.0000E+04	2.9813E+00	5.0000E+04	2.6864E+00	6.0000E+04	2.4705E+00	7.0000E+04	2.3032E+00
16	8.0000E+04	2.1683E+00	9.0000E+04	2.0558E+00	1.0000E+05	1.9596E+00	1.1000E+05	1.8755E+00	1.2000E+05	1.8008E+00
21	1.3000E+05	1.7334E+00	1.4000E+05	1.6718E+00	1.5000E+05	1.6149E+00	1.6000E+05	1.5619E+00	1.7000E+05	1.5123E+00
26	1.8000E+05	1.4653E+00	1.9000E+05	1.4209E+00	2.0000E+05	1.3787E+00	2.0500E+05	1.3583E+00	2.1000E+05	1.3383E+00
31	2.1500E+05	1.3188E+00	2.2000E+05	1.2997E+00	2.2500E+05	1.2811E+00	2.3000E+05	1.2627E+00	2.3500E+05	1.2448E+00
36	2.4000E+05	1.2271E+00	2.4500E+05	1.2099E+00	2.5000E+05	1.1929E+00	2.6000E+05	1.1600E+00	2.7000E+05	1.1283E+00
41	2.8000E+05	1.0979E+00	2.9000E+05	1.0689E+00	3.0000E+05	1.0415E+00	3.1000E+05	1.0156E+00	3.2000E+05	9.9153E-01
46	3.3000E+05	9.6940E-01	3.4000E+05	9.4932E-01	3.5000E+05	9.3133E-01	3.6000E+05	9.1549E-01	3.7000E+05	9.0175E-01
51	3.8000E+05	8.8994E-01	3.9000E+05	8.7989E-01	4.0000E+05	8.7131E-01	4.1000E+05	8.6384E-01	4.2000E+05	8.5702E-01
56	4.3000E+05	8.5036E-01	4.4000E+05	8.4330E-01	4.5000E+05	8.3536E-01	4.6000E+05	8.2606E-01	4.6500E+05	8.2079E-01
61	4.7000E+05	8.1503E-01	4.7500E+05	8.0879E-01	4.8000E+05	8.0202E-01	4.8500E+05	7.9476E-01	4.9000E+05	7.8695E-01
66	4.9500E+05	7.7864E-01	5.0000E+05	7.6985E-01	5.0500E+05	7.6060E-01	5.1000E+05	7.5091E-01	5.1500E+05	7.4083E-01
71	5.2000E+05	7.3040E-01	5.3000E+05	7.0867E-01	5.4000E+05	6.8608E-01	5.6000E+05	6.3976E-01	5.8000E+05	5.9393E-01
76	6.0000E+05	5.5028E-01	6.2000E+05	5.0985E-01	6.4000E+05	4.7303E-01	6.6000E+05	4.3982E-01	6.8000E+05	4.1008E-01
81	7.0000E+05	3.8352E-01	7.2000E+05	3.5984E-01	7.4000E+05	3.3870E-01	7.6000E+05	3.1984E-01	7.8000E+05	3.0298E-01
86	8.0000E+05	2.8790E-01	8.2000E+05	2.7446E-01	8.4000E+05	2.6244E-01	8.6000E+05	2.5169E-01	8.8000E+05	2.4209E-01
91	9.0000E+05	2.3355E-01	9.2000E+05	2.2603E-01	9.4000E+05	2.1944E-01	9.6000E+05	2.1381E-01	9.8000E+05	2.0918E-01
96	1.0000E+06	2.0565E-01	1.1000E+06	1.9749E-01	1.2000E+06	2.0028E-01	1.3000E+06	2.1236E-01	1.4000E+06	2.3468E-01
101	1.5000E+06	2.7524E-01	1.5500E+06	3.0762E-01	1.6000E+06	3.5292E-01	1.6500E+06	4.0871E-01	1.7000E+06	4.6710E-01
106	1.7500E+06	5.2382E-01	1.8000E+06	5.5860E-01	1.8500E+06	5.7792E-01	1.9000E+06	5.8026E-01	1.9500E+06	5.6548E-01
111	2.0000E+06	5.4100E-01	2.0500E+06	5.1229E-01	2.1000E+06	4.7788E-01	2.1500E+06	4.4458E-01	2.2000E+06	4.1416E-01
116	2.2500E+06	3.8592E-01	2.3000E+06	3.6060E-01	2.3500E+06	3.4059E-01	2.4000E+06	3.3000E-01	2.4500E+06	3.2976E-01
121	2.5000E+06	3.2870E-01	2.5500E+06	3.5126E-01	2.6000E+06	3.6800E-01	2.6500E+06	3.8250E-01	2.7000E+06	3.9680E-01
126	2.7500E+06	4.0750E-01	2.8000E+06	4.0910E-01	2.8500E+06	3.9960E-01	2.9000E+06	3.8620E-01	2.9500E+06	3.7330E-01
131	3.0000E+06	3.6150E-01	3.0500E+06	3.5202E-01	3.1000E+06	3.4360E-01	3.1500E+06	3.3717E-01	3.2000E+06	3.3120E-01
136	3.3000E+06	3.2421E-01	3.4000E+06	3.2020E-01	3.6000E+06	3.3750E-01	3.7000E+06	3.5640E-01	3.8000E+06	3.8120E-01
141	4.0000E+06	4.3260E-01	4.2000E+06	4.8480E-01	4.3000E+06	5.0370E-01	4.4000E+06	5.1240E-01	4.6000E+06	5.4123E-01
146	4.8000E+06	5.7929E-01	5.0000E+06	6.0580E-01	5.2000E+06	6.1010E-01	5.4000E+06	6.1230E-01	5.5000E+06	6.1190E-01
151	5.6000E+06	6.1337E-01	5.8000E+06	6.1396E-01	6.0000E+06	5.9434E-01	6.2000E+06	5.5321E-01	6.4000E+06	5.0265E-01
156	6.6000E+06	4.6638E-01	6.8000E+06	4.6230E-01	7.0000E+06	4.5630E-01	7.2000E+06	4.5289E-01	7.4000E+06	4.5699E-01
161	7.6000E+06	4.6119E-01	7.8000E+06	4.6291E-01	8.0000E+06	4.6370E-01	8.2000E+06	4.6550E-01	8.4000E+06	4.6891E-01
166	8.6000E+06	4.7269E-01	8.8000E+06	4.7694E-01	9.0000E+06	4.7735E-01	9.2000E+06	4.7892E-01	9.4000E+06	4.8102E-01
171	9.6000E+06	4.8403E-01	9.8000E+06	4.8813E-01	1.0000E+07	4.9313E-01	1.0500E+07	5.1084E-01	1.1000E+07	5.2840E-01
176	1.1500E+07	5.4014E-01	1.2000E+07	5.5311E-01	1.2500E+07	5.6628E-01	1.3000E+07	5.7385E-01	1.3500E+07	5.7887E-01
181	1.4000E+07	5.8395E-01	1.4500E+07	5.8548E-01	1.5000E+07	5.8651E-01	1.5500E+07	5.8826E-01	1.6000E+07	5.9062E-01
186	1.6500E+07	5.8845E-01	1.7000E+07	5.8951E-01	1.7500E+07	5.9206E-01	1.8000E+07	5.9613E-01	1.8500E+07	5.9829E-01
191	1.9000E+07	6.0044E-01	1.9500E+07	6.0371E-01	2.0000E+07	6.0651E-01				


10B σnα
74 GRT Fr
69 LRC Bo
68 ORL Ma
67 ALD Co
65 ANL Mo
65 ANL Mo
60 DKE Bi
57 RIC Bi
En(keV)
σ(b)

Evaluation of Sodium-23 Neutron Capture Cross Section Data for the ENDF/B V-III File*†

by

N.C. Paik and T.A. Pitterle

Westinghouse Advanced Reactors Division

Waltz Mill Site P.O. Box 158

Madison, Pennsylvania 15663

This report describes the evaluation of neutron cross sections of Na-23, material number 1156, for the ENDF/B File. Cross sections were evaluated between 10^{-5} eV and 15 MeV.† Experimental data available up to March 1971 were included in the evaluation.

The total cross section of sodium has been re-evaluated for the ENDF/B library in the neutron energy range from 100 eV to 15 MeV. The measurement of the total cross section for neutron energies above 600 eV and below 40 keV at the Nevis Laboratory, Columbia University[(2)] verifies a spin assignment of J=1 for the 2.85 keV resonance and a neutron width of about 410 eV. The data indicates that the width of the resonance is wider than the earlier measurements by Garg[(3)], and more in agreement with the measurements of Moxon[(4)] and Lynn.[(5)] The peak value of the resonance is

---

*Work performed under AEC Contract AT(30-1)-4210.

†Data extrapolated to 20 MEV at NNCSC and carried over to Version IV.

This report extracted from ENDF/B Summary Documentation ENDF 201 BNL 17541 (May 1973).

within the statistical uncertainty of the theoretical value, which is 380 barns for a resonance with J=1.

Resonance parameters are given in Table 1. Yamamuro's[6] measured value of 0.47 eV for Γ_γ of the 2.85 keV resonance has been used in the present evaluation. Parameters for resonances at 7.53, 35.4, 53.0, 114.7, 129.5, and 139.1 keV were estimated from data by Moxon[4], Hockenbury[7], and Ribon[8] with particular emphasis on the capture areas measured by Hockenbury.[7] The parameters for the 53.0 keV resonance, for instance, are Moxon's values with Hockenbury's Γ_γ data.

The scattering radius was chosen to provide a good agreement between calculation for the 2.85 keV resonance at energies above the resonance with measured data from the Nevis Laboratory.[2] Background cross sections are given in File 3 to improve agreement between calculated and measured data below 1.50 keV. The resolved resonance range is defined to be from 600 eV to 150 keV. Below 600 eV the total cross section is based on the data of Columbia[2] and of Joki.[9]

The sodium capture cross section between 100 eV and 200 keV is based primarily on the resonance parameter evaluation and in agreement with the capture areas measured by Hockenbury.[7] The radiation width for the 2.85 keV resonance, which dominates Na capture cross section, is 0.47 eV[6] compared to 0.33 eV for the ENDF/B Version 1 evaluation. Integral testing[10] of this capture cross section change of sodium indicated that the eigenvalue calculation of a fast reactor system with a power reactor spectrum is

Table 1

Resonance Parameters in ENDF/B Version III Sodium Evaluation

Resonance Energy, keV	J	l	Γn,eV	$\Gamma\gamma$,eV
2.85	1	0	410	0.47
7.53	1	1	0.012	1.5
35.4	3	1	0.86	0.76
53.0	2	1	1200	1.48
114.7	2	0	11.0	2.72
129.5	3	1	0.374	1.5
139.1	2	1	3.33	1.5

not significantly affected (0.01% Δk change *for* $\Gamma\gamma$ = 0.33 eV).

Above 200 keV and below 100 eV, the capture cross section of the Version I sodium evaluation[(1)] was retained for the present evaluation.

References

1. T.A. Pitterle, "Evaluated Neutron Cross Sections of Na^{23} for the ENDF/B File," APDA-217, (June 1968).

2. F. Rahn et al., Private Communication, Nevis Laboratory, Columbia University, (1968).

3. J.B. Garg, J. Rainwater, S. Winchank, and W.W. Havens, Jr., "Total Cross Section of Elements with Widely Spaced Levels in the Energy Interval of 200 eV-600 keV," in Nuclear Structure With Neutrons, Procedings of the International Conference on the Study of Nuclear Structure with Neutrons, Antwerp, Belgium, 526, (July 19-23, 1965), North-Holland Publishing Company, Amsterdam, (1966).

4. M.C. Moxon and N.J. Pattenden, CN-23/27, Paris Conference, (1966).

5. J.E. Lynn, F.W.K. Firk, and M.C. Moxon, "The 2.85 keV Neutron Resonance of Sodium," Nucl. Phys. 5, 603-614 (1957).

6. N. Yamamuro, R.W. Hockenbury, R.C. Block, and R.H. Wolfe, "A Measurement of the Radiation Width of the 2.85 keV Neutron Resonance and of the Thermal Neutron Capture Cross Section in Sodium," Nucl. Sci. Eng. 41, 445-449 (1970).

7. R.W. Hockenbury, Z.M. Bartholome, J.R. Tatarczuk, W.R. Moyer, and R.C. Block," Neutron Radiative Capture in Na, Al, Fe, and Ni from 1 to 200 keV," Physics Rev., 178, 1746-1769 (1969).

8. P. Ribon et al., CN-23/72, Paris Conference, (1966).

9. Joki, Miller, Evans, Phy. Rev. 109, 610 (1955).

10. N.C. Paik, T.A. Pitterle, and C. Durston, "Integral Testing of Modifications to ENDF/B Version II Data", in Proceedings of the Third Conference Neutron Cross Sections and Technology, CONF-710301, Vol. 1, 44-50 (August 1971).

SODIUM-23 RESONANCE DATA ENDF/B MATERIAL NO. 6156
RESONANCE PARAMETERS

ISOTOPE----------------------------SODIUM-23
FRACTIONAL ABUNDANCE--------- 1.0000E+00
NUMBER OF ENERGY RANGES------ 1

ENERGY RANGE NUMBER---------- 1 RESOLVED SINGLE-LEVEL BREIT-WIGNER PARAMETERS
LOWER ENERGY LIMIT (EV)------ 6.0000E+02
UPPER ENERGY LIMIT (EV)------ 1.5000E+05
NUCLEAR SPIN----------------- 1.5000E+00
SPIN SCATTERING LENGTH (A+)-- 5.3000E-01
NUMBER OF L STATES----------- 2

L VALUE---------------------- 0
NUMBER OF RESONANCES--------- 2
SPIN SCATTERING LENGTH (A-)-- 0.0000E+00

INDEX	ENERGY (EV)	J VALUE	TOTAL	RESONANCE WIDTHS (EV) NEUTRON	RADIATION	FISSION
1	2.8500E+03	1.0000E+00	4.1047E+02	4.1000E+02	4.7000E-01	0.0000E+00
2	1.1470E+05	2.0000E+00	1.3720E+01	1.1000E+01	2.7200E+00	0.0000E+00

L VALUE---------------------- 1
NUMBER OF RESONANCES--------- 5
SPIN SCATTERING LENGTH (A-)-- 0.0000E+00

INDEX	ENERGY (EV)	J VALUE	TOTAL	RESONANCE WIDTHS (EV) NEUTRON	RADIATION	FISSION
1	7.5300E+03	1.0000E+00	1.5120E+00	1.2000E-02	1.5000E+00	0.0000E+00
2	3.5400E+04	3.0000E+00	1.6200E+00	8.6000E-01	7.6000E-01	0.0000E+00
3	5.3000E+04	2.0000E+00	1.2015E+03	1.2000E+03	1.4800E+00	0.0000E+00
4	1.2950E+05	3.0000E+00	1.8740E+00	3.7400E-01	1.5000E+00	0.0000E+00
5	1.3910E+05	2.0000E+00	4.8300E+00	3.3300E+00	1.5000E+00	0.0000E+00

SODIUM-23 (N,GAMMA) ENDF/B MATERIAL NO. 6156
NEUTRON CROSS SECTION

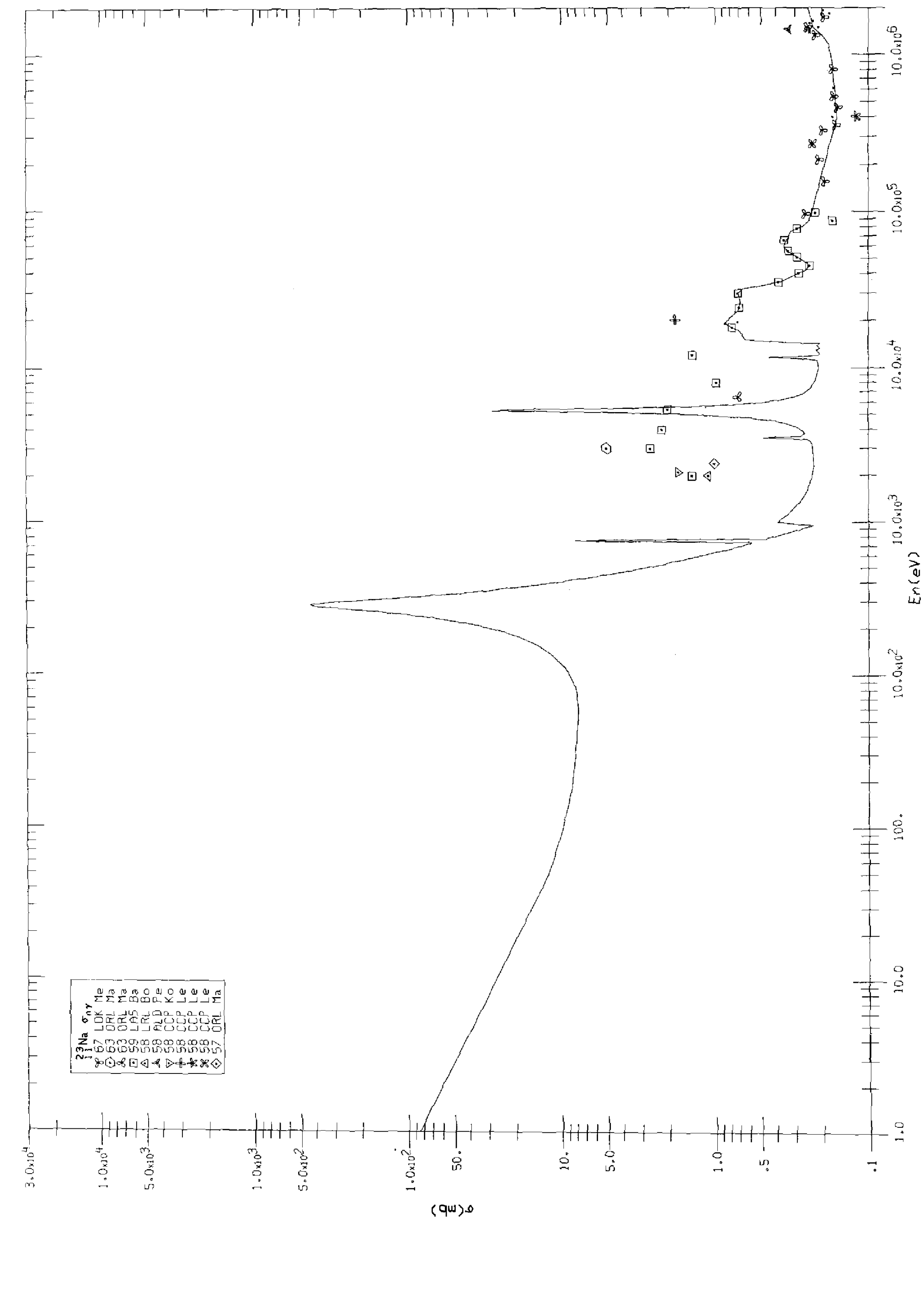
REACTION Q VALUE 6.9615E+06 EV

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION	RANGE	DESCRIPTION	RANGE	DESCRIPTION
1 TO 18	LN Y LINEAR IN LN X	18 TO 23	Y LINEAR IN X	23 TO 51	LN Y LINEAR IN LN X
51 TO 52	Y LINEAR IN X				

NEUTRON CROSS SECTIONS

INDEX,	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	1.0000E-05	2.6860E+01	1.0000E-03	2.6860E+00	1.0000E-02	8.4940E-01	2.5300E-02	5.3400E-01	4.0000E-02	4.2470E-01
6	1.0000E-01	2.6860E-01	2.0000E-01	1.8990E-01	5.0000E-01	1.2010E-01	1.0000E+00	8.4940E-02	1.0000E+01	2.6860E-02
11	5.0000E+01	1.2100E-02	1.0000E+02	9.8000E-03	1.5000E+02	8.9000E-03	2.0000E+02	8.4000E-03	3.0000E+02	8.1000E-03
16	4.0000E+02	7.9000E-03	5.0000E+02	7.8000E-03	6.0000E+02	7.7300E-03	6.0000E+02	0.0000E+00	9.5000E+03	0.0000E+00
21	1.0000E+04	2.0000E-04	1.5000E+05	2.0000E-04	1.5000E+05	6.3000E-04	1.6000E+05	6.6000E-04	1.7200E+05	7.0000E-04
26	1.8300E+05	8.0000E-04	1.9000E+05	8.6000E-04	2.0600E+05	8.0000E-04	2.3000E+05	7.0000E-04	2.4000E+05	6.9000E-04
31	2.6000E+05	6.8000E-04	3.0000E+05	7.0000E-04	3.2000E+05	6.5000E-04	3.5000E+05	3.8000E-04	4.2000E+05	2.5000E-04
36	4.5000E+05	2.4000E-04	4.5800E+05	2.4400E-04	4.7000E+05	2.5000E-04	5.5000E+05	3.3000E-04	6.0000E+05	3.5000E-04
41	6.6000E+05	3.5000E-04	7.5000E+05	3.2000E-04	8.0000E+05	2.7000E-04	8.8000E+05	2.4000E-04	1.0000E+06	2.3000E-04
46	4.0000E+06	1.6000E-04	4.5000E+06	1.6000E-04	8.0000E+06	1.7000E-04	1.1500E+07	1.8000E-04	1.3300E+07	2.0000E-04
51	1.5000E+07	2.3000E-04	2.0000E+07	2.4541E-04						


En(eV)
σ(mb)

REFERENCES FOR EXPERIEMNTAL DATA

$^{23}Na(n,\gamma)$

Yr.	Lab	Author	References
72	RBZ	Holub, et al.	LNS-4-72 (1972)
70	RPI	Yamamuro, et al.	Nuc. Sci.&Eng. 41, 445 (1970)
67	DEB	Csikai, et al.	Nuc. Phys./A 95, 229 (1967)
67	LOK	Menlove, et al.	Phys. Rev. 163, 1299 (1967)
63	ORL	Macklin, et al.	Phys. Rev. 129, 2695 (1963)
61	ANL	Meadows, et al.	Nuc. Sci.&Eng. 9, 132 (1961)
59	LAS	Bame, et al.	Phys. Rev. 113, 256 (1959)
59	ORL	Lyon, et al.	Phys. Rev. 114, 1619 (1959)
58	LRL	Booth, et al.	Phys. Rev. 112, 226 (1958)
58	ALD	Perkin, et al.	Proc. Phys. Soc. 72, 505 (1958)
58	CCP	Kononov, et al.	At. En. 5, 564 (1958)
58	CCP	Leipunsky, et al.	Second Peaceful Uses of At. En. Conf. Geneva Vol 15, 5 (1958)
57	ORL	Macklin, et al.	Phys. Rev. 107, 504 (1957)

Evaluation of the $^{27}Al(n,p)^{27}Mg$ and $^{27}Al(n,\alpha)^{24}Na$

Cross Sections* for ENDF/B-IV

P.G. Young and D.G. Foster, Jr.

Los Alamos Science Laboratory

Theoretical Division March '72

The Version III ENDF/B cross sections for the $^{27}Al(n,p)^{27}Mg$ and $^{27}Al(n,\alpha)^{24}Na$ reactions were examined with the aim of implementing several improvements for standards use. The suggested revisions are described below and in the accompanying figures, where the recommended Version IV data are compared to experimental results as well as to other evaluations.

$^{27}Al(n,p)^{27}Mg$

The only change suggested for the Version III ENDF/B (n,p) cross section (Yo72) is for neutron energies below 4 MeV. At these energies the data were modified to correspond more closely to the Henkel (He54) and Grundl (Gr67) measurements, which are in good agreement. The recommended curve from threshold to 7 MeV is compared to the available measurements in Fig. 1. The energy dependence of the curve below 3 MeV is represented by an $\ell = 0$ penetrability function for the outgoing p + ^{27}Mg channel. From 4 to 7 MeV the recommended curve is based on a composite of the available measurements (Ba65, Ca62, Gr67, He54).

*Submitted to Normalization and Standards Subcommittee March 1972. This evaluation has since been incorporated into the ENDF/B-IV general purpose library.

The recommended curve is compared to the available activation measurements from 7 to 13 MeV in Fig. 2, and from 13 to 20 MeV in Fig. 3. It should be noted that the data of Ferguson (Fe67), which are substantially lower than the evaluation, are relative data that have been normalized to a value of 55 mb near 13 MeV. Similarly, absolute data were obtained at only one energy (50 mb at 14.4 MeV) in the Gabbard measurement (Ga62), and the remaining points were normalized to that value. Therefore, since the preponderance of experimental results near 14 MeV suggests a substantially higher (n,p) cross section, the evaluation was chosen to approximately follow the measurements of Mani (Ma60), resulting in an evaluated cross section of 77 mb at 14.1 MeV.

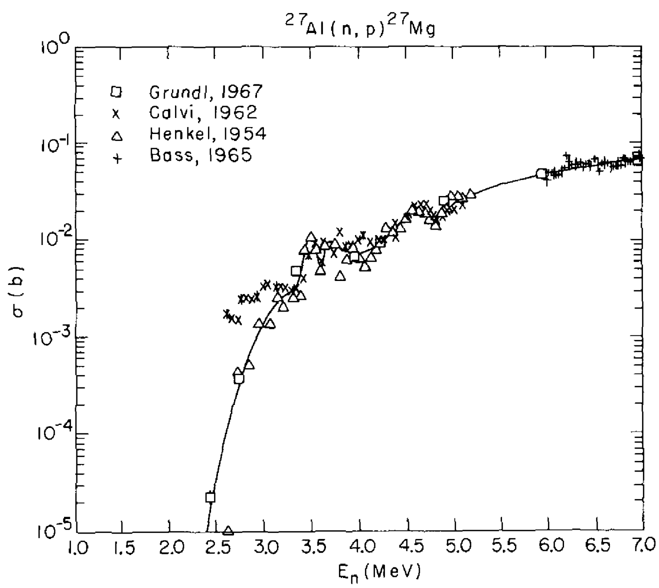


Figure 1

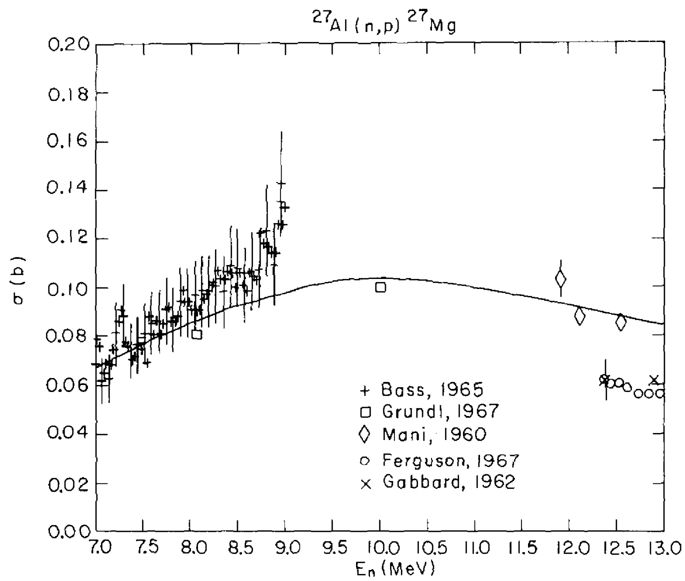


Figure 2

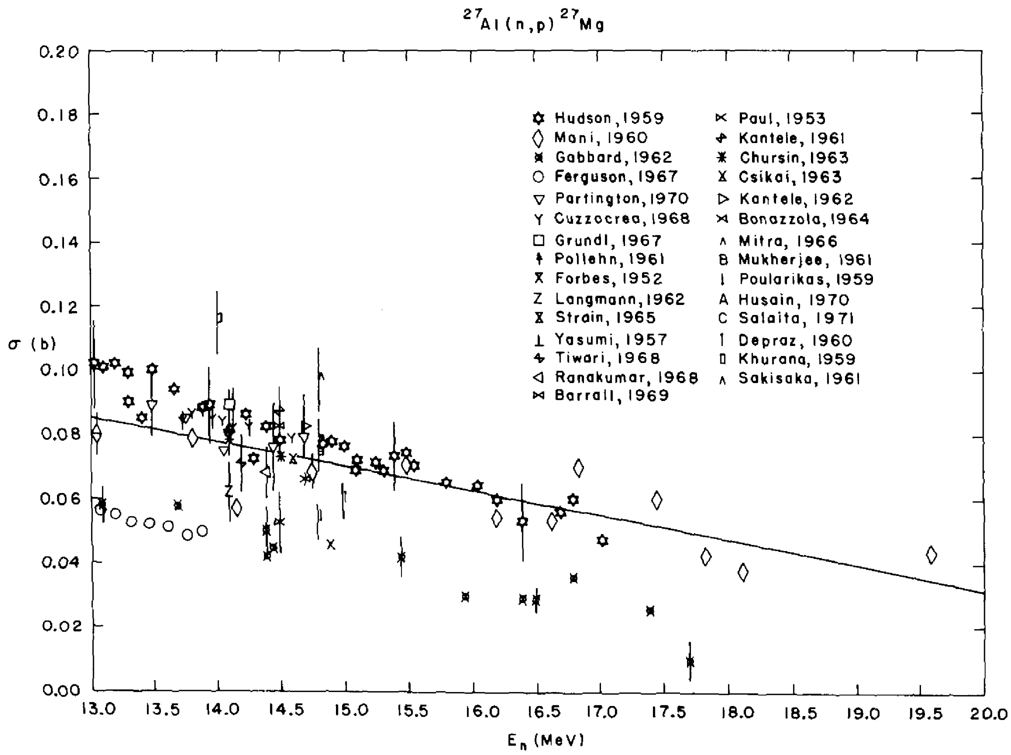


Figure 3

$^{27}Al(n,\alpha)^{24}Na$

The recommended curve for the (n,α) cross section was changed somewhat from the ENDF/B-III values to better agree with the experimental data of Butler (Bu63), Liskien (Li66), and Paulsen (Pa65). The new curve is compared to the experimental data from threshold to 9 MeV in Fig. 4. The energy dependence of the curve below 6 MeV is approximated by an $\ell = 0$ penetrability function for the $\alpha + {}^{24}Na$ channel. The results from 6 to 13 MeV and from 13 to 20 MeV are shown on linear scales in Figs. 5 and 6. It is interesting to note that if the measurements of Tewes (Te60) are renormalized by a factor of 1.37, very good agreement is obtained with the Butler data (Bu63). The recommended curve has a value of 124 mb at 14.1 MeV.

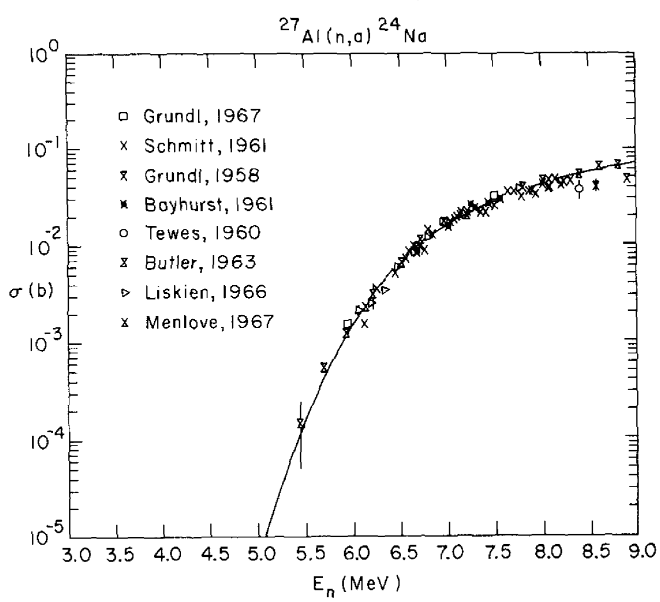
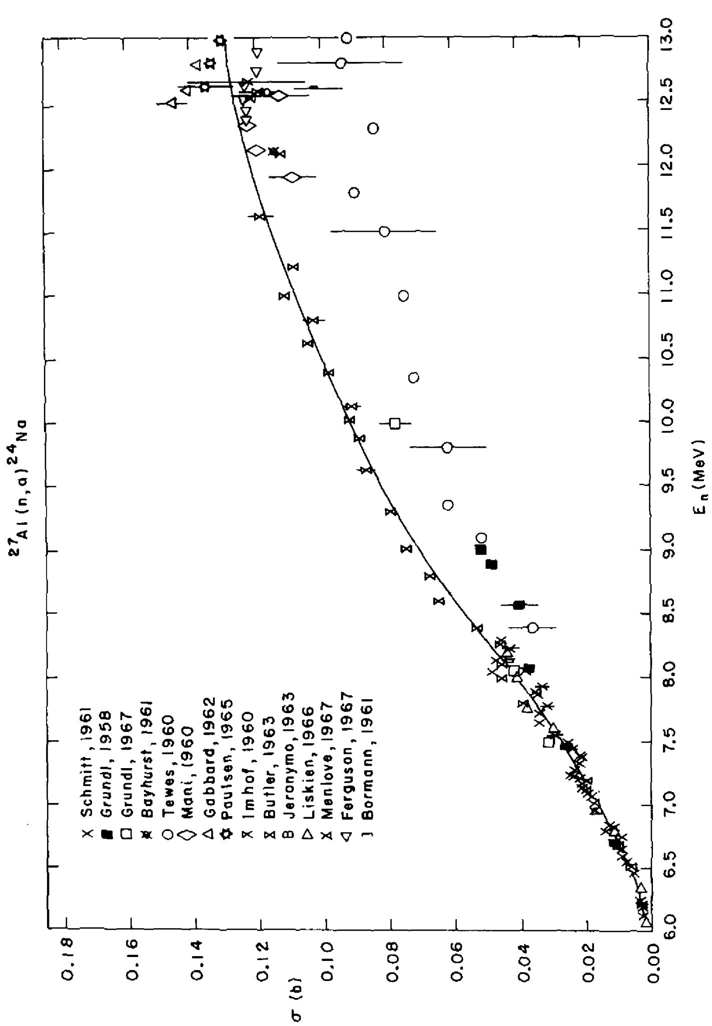
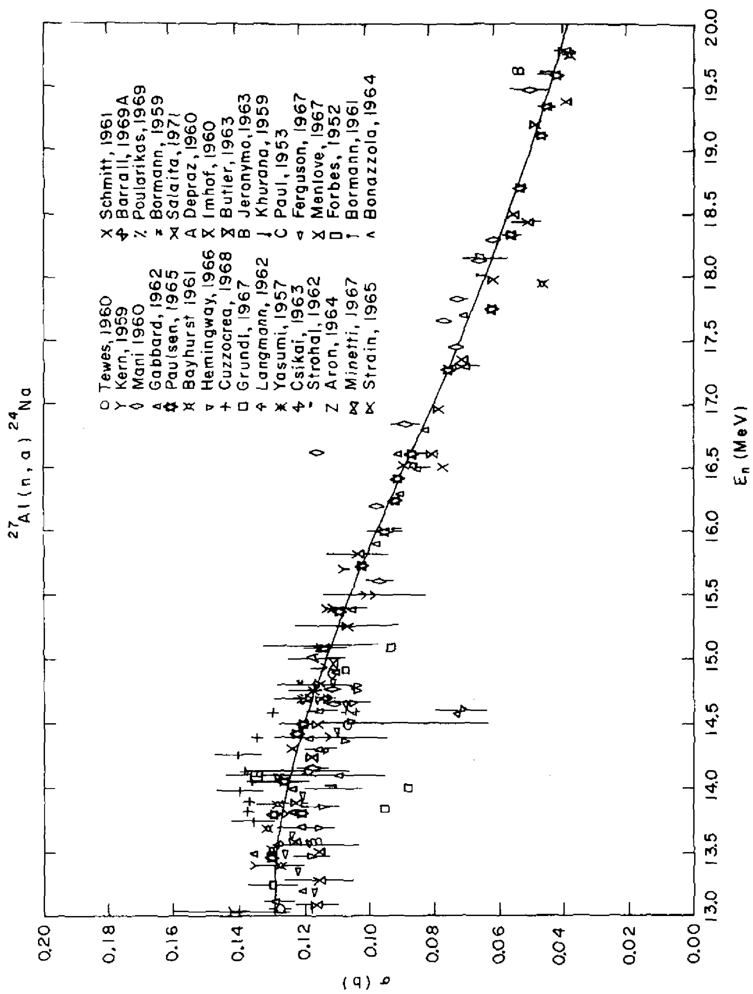


Figure 4



$^{27}Al(n,\alpha)^{24}Na$
σ (b)
E_n (MeV)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
10.0
10.5
11.0
11.5
12.0
12.5
13.0
Schmitt, 1961
Grundl, 1958
Grundl, 1967
Bayhurst, 1961
Tewes, 1960
Mani, 1960
Gabbard, 1962
Paulsen, 1965
Imhof, 1960
Butler, 1963
Jeronymo, 1963
Liskien, 1966
Menlove, 1967
Ferguson, 1967
Bormann, 1961

Figure 5



27Al(n, α) 24Na
Tewes, 1960
Kern, 1959
Mani 1960
Gabbard, 1962
Paulsen, 1965
Bayhurst 1961
Hemingway, 1966
Cuzzocrea, 1968
Grundl, 1967
Langmann, 1962
Yasumi, 1957
Csikai, 1963
Strohal, 1962
Aron, 1964
Minetti, 1967
Strain, 1965
Schmitt, 1961
Barrall, 1969A
Poularikas, 1969
Bormann, 1959
Salaita, 1971
Depraz, 1960
Imhof, 1960
Butler, 1963
Jeronymo, 1963
Khurana, 1959
Paul, 1953
Ferguson, 1967
Menlove, 1967
Forbes, 1952
Bormann, 1961
Bonazzola, 1964
σ (b)
En (MeV)

Figure 6

References

Ar64 P.M. Aron et al., Atom. Energiya 16, 450 (1964).

Ba61 B.P. Bayhurst and R.J. Prestwood, Phys. Rev. 121, 1438 (1961).

Ba65 R. Bass, EANDC(E)-66U, p. 64 (1966) and private communication (1966).

Ba69 R.C. Barrall et al., SUHP-69-2 (1969).

Ba69a R.C. Barrell and M. Silbergeld, Nucl. Phys. A138, 387 (1969).

Bo61 M. Bormann et al., J. Phys. Radium 22, 602 (1961).

Bo64 G.C. Bonazzola et al., Nucl. Phys. 51, 337 (1964).

Bo65 M. Bormann et al., Nucl. Phys. 63, 438 (1965).

Br70 A.M. Bresesti et al., Nucl. Sci. Eng. 40, 331 (1970).

Bu63 J.P. Butler and D.C. Santry, Can. J. Phys. 41, 372 (1963).

Ca62 G. Calvin et al., Nucl. Phys. 39, 621 (1962).

Ch63 G.P. Chursin et al., JETP 44, 472 (1963).

Cs63 J. Csikai et al., Nucl. Phys. 46, 141 (1963).

Cu68 P. Cuzzocrea and E. Perillo, Nuovo Cimento B54, 53 (1968).

De60 M.J. DePraz et al., J. Phys. Radium 21, 377 (1960).

Fe67 J.M. Ferguson and J.C. Albergotti, Nucl. Phys. A98, 65 (1967).

Fo52 S.G. Forbes, Phys. Rev. 88, 1309 (1952).

Ga62 F. Gabbard and B.D. Kern, Phys. Rev. 128, 1276 (1962).

Gr58 J.A. Grundl et al., Phys. Rev. 109, 425 (1958).

Gr67 J.A. Grundl, Nucl. Sci. Eng. 30, 39 (1967).

He54 R.L. Henkel, private communication via BNL Sigma Center (1954).

He66 J.D. Hemingway et al., Proc. Roy. Soc. (London) A292, 180 (1966).

Hu59 O.M. Hudson, Jr. et al., "Neutron Interactions in Lithium, Carbon, Nitrogen, Aluminum, Argon, Manganese, Yttrium, Zirconium, Radiolead, and Bismuth," WADC-TN-59-107 (1959).

Hu70 L. Husain et al., Phys. Rev. C1, 1233 (1970).

Im60 W.L. Imhoff, private communication to Sigma Center BNL (1960).

Je63 J.M. Jeronymo et al., Nucl. Phys. 47, 157 (1963).

Ka61 J. Kantele, Bull. Am. Phys. Soc. 6, 252 (1961).

Ka62 J. Kantele and D.G. Gardner, Nucl. Phys. 35, 353 (1962).

Ke59 B.D. Kern et al., Nucl. Phys. 10, 226 (1959).

Kh59 C.S. Khurana and H.S. Hans, Nucl. Phys. 13, 88 (1959).

La62 J. Langmann, private communication to Sigma Center, BNL (1962).

Li65 H. Liskien and A. Paulsen, Nucleonics 8, 315 (1966).

Ma60 G.S. Mani et al., Nucl. Phys. 19, 535 (1960).

Me67 H.O. Menlove et al., Phys. Rev. 163, 1308 (1967).

Mi66 B. Mitra and A.M. Ghose, Nucl. Phys. 83, 157 (1966).

Mi67 B. Minetti and A. Pasquarelli, Z. Physik 199, 275 (1967).

Mu60 S.K. Mukherjee et al., Proc. Phys. Soc. (London) 77, 508 (1961).

Pa53 E.B. Paul and R.L. Clarke, Can J. Phys. 31, 267 (1953).

Pa65 A. Paulsen and H. Liskien, J. Nucl. Energy 19, 907 (1965).

Pa70 D. Partington et al., Analyst 95, 257 (1970).

Po59 A. Poularikas and R.W. Fink, Phys. Rev. 115, 989 (1959).

Po61 H. Pollehn and H. Neuert, Z. Naturforsch. 16A, 227 (1961).

Ra68 N. Ramakumar et al., Nucl. Phys. A122, 679 (1968).

Sa61 M. Sakisaka et al., J. Phys. Soc. Japan 16, 1869 (1961).

Sa71 G.N. Salaita, Nucl. Phys. A170, 193 (1971).

Sc61 H.W. Schmitt and J. Halperin, Phys. Rev. 121, 827 (1961).

Si70 R.L. Simons and W.N. McElroy, "Evaluated Reference Cross Section Library," BNWL-1312 (1970).

St62 P. Strohal et al., Nucl. Phys. 30, 49 (1962).

St65 J.E. Strain and W.J. Ross, "14-MeV Neutron Reactions," ORNL-3672 (1965).

Te60 H.A. Tewes et al., "Excitation Functions of Neutron-Induced Reactions," UCRL-6028-T (1960).

Ti68 P.I. Tiwari and E. Kondaiah, Phys. Rev. 167, 1091 (1968).

Ya57 S. Yasumi, J. Phys. Soc. Japan 12, 443 (1957).

Yo72 P.G. Young and D.G. Foster, Jr., "A Preliminary Evaluation of the Neutron and Photon Production Cross Sections of Aluminum," LA-4726 (TBP 1972).

ALUMINUM-27 (N,P) NEUTRON CROSS SECTION ENDF/B MATERIAL NO. 6193

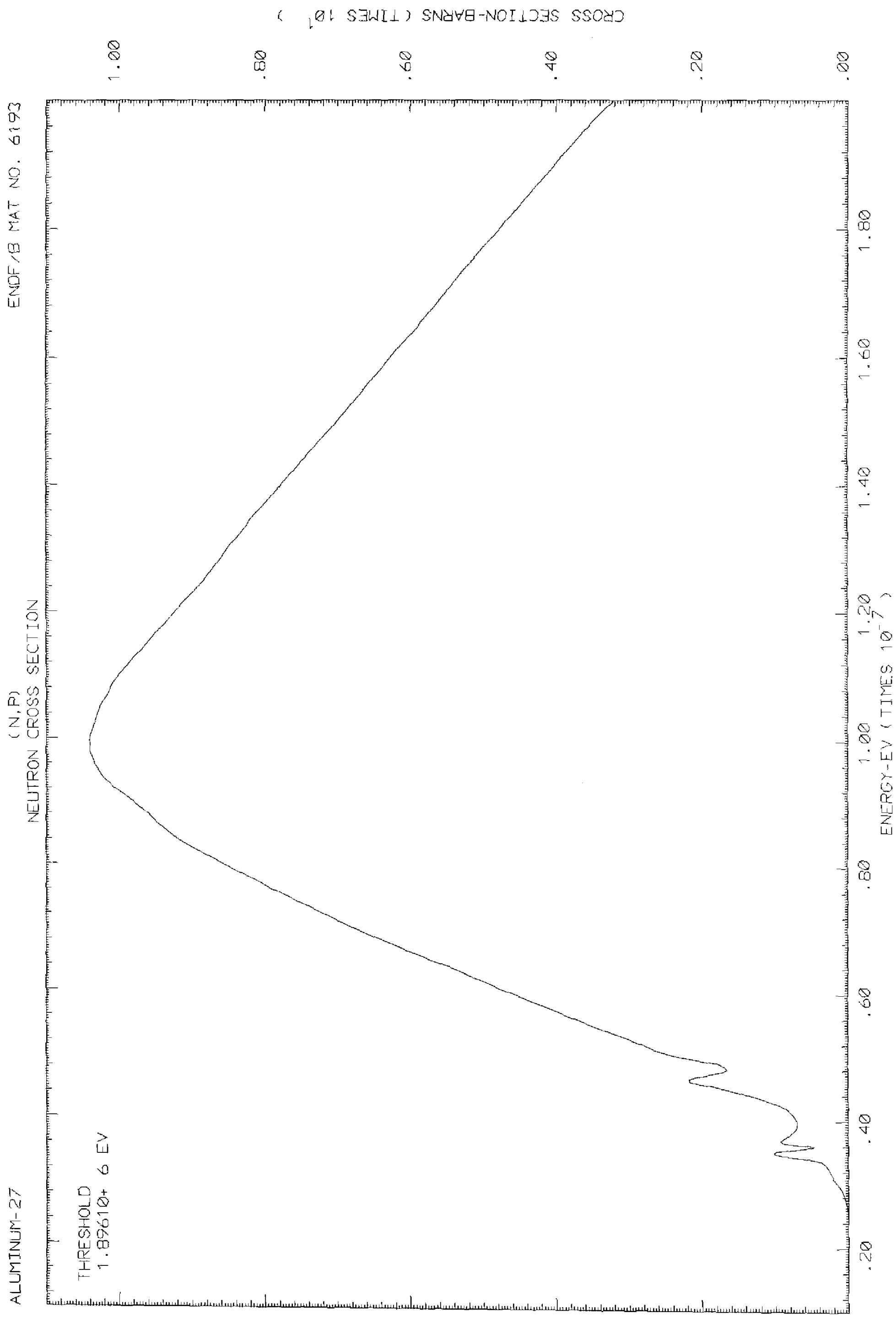
REACTION Q VALUE -1.8278E+06 EV

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION	RANGE	DESCRIPTION	RANGE	DESCRIPTION
1 TO 3	Y LINEAR IN X	3 TO 23	LN Y LINEAR IN X	23 TO 114	Y LINEAR IN X

NEUTRON CROSS SECTIONS

INDEX,	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	1.8961E+06	0.0000E+00	2.0000E+06	9.0900E-15	2.0500E+06	2.1804E-12	2.1000E+06	5.2300E-10	2.1500E+06	9.7487E-09
6	2.2000E+06	6.6000E-08	2.2500E+06	3.3021E-07	2.3000E+06	1.1500E-06	2.3500E+06	3.3202E-06	2.4000E+06	8.0000E-06
11	2.4500E+06	1.7089E-05	2.5000E+06	3.2800E-05	2.5500E+06	5.8352E-05	2.6000E+06	9.6900E-05	2.6500E+06	1.5262E-04
16	2.7000E+06	2.2900E-04	2.7500E+06	3.2998E-04	2.8000E+06	4.5900E-04	2.8500E+06	6.2082E-04	2.9000E+06	8.1800E-04
21	2.9500E+06	1.0538E-03	3.0000E+06	1.3300E-03	3.0100E+06	1.3907E-03	3.1000E+06	2.0100E-03	3.2000E+06	2.4600E-03
26	3.3000E+06	2.9300E-03	3.3300E+06	3.1782E-03	3.3600E+06	3.6254E-03	3.3700E+06	3.8603E-03	3.3800E+06	4.1780E-03
31	3.4000E+06	5.1000E-03	3.4200E+06	6.3360E-03	3.4500E+06	8.9000E-03	3.4700E+06	9.8640E-03	3.4900E+06	1.0156E-02
36	3.5000E+06	1.0100E-02	3.5200E+06	9.7800E-03	3.5300E+06	9.2800E-03	3.5800E+06	5.3400E-03	3.5900E+06	4.8300E-03
41	3.6000E+06	4.6000E-03	3.6100E+06	4.9780E-03	3.6200E+06	5.6520E-03	3.6500E+06	8.7000E-03	3.6600E+06	9.0620E-03
46	3.6800E+06	9.2120E-03	3.7000E+06	9.1000E-03	3.8000E+06	7.7000E-03	3.8800E+06	7.0760E-03	3.9000E+06	7.0000E-03
51	3.9900E+06	6.9423E-03	4.0000E+06	6.9667E-03	4.1000E+06	7.5000E-03	4.1500E+06	7.9521E-03	4.2000E+06	8.6000E-03
56	4.2500E+06	9.5437E-03	4.3000E+06	1.0700E-02	4.4000E+06	1.3500E-02	4.5000E+06	1.7000E-02	4.5500E+06	1.9000E-02
61	4.6000E+06	2.1556E-02	4.6500E+06	2.1742E-02	4.7000E+06	2.0000E-02	4.7500E+06	1.7500E-02	4.8000E+06	1.6500E-02
66	4.8500E+06	1.6775E-02	4.9000E+06	1.8000E-02	5.0000E+06	2.3300E-02	5.1000E+06	2.6340E-02	5.2000E+06	2.8336E-02
71	5.4000E+06	3.3164E-02	5.6000E+06	3.7704E-02	5.8000E+06	4.2076E-02	6.0000E+06	4.6400E-02	6.2000E+06	5.0616E-02
76	6.4000E+06	5.4864E-02	6.6000E+06	5.9288E-02	6.8000E+06	6.3672E-02	7.0000E+06	6.7800E-02	7.2000E+06	7.1552E-02
81	7.4000E+06	7.5208E-02	7.6000E+06	7.8800E-02	7.8000E+06	8.2280E-02	8.0000E+06	8.5600E-02	8.2000E+06	8.8976E-02
86	8.4000E+06	9.1904E-02	8.6000E+06	9.4144E-02	8.8000E+06	9.6056E-02	9.0000E+06	9.8000E-02	9.2000E+06	1.0048E-01
91	9.4000E+06	1.0232E-01	9.6000E+06	1.0340E-01	9.8000E+06	1.0390E-01	1.0000E+07	1.0400E-01	1.0500E+07	1.0252E-01
96	1.1000E+07	1.0000E-01	1.1500E+07	9.6015E-02	1.2000E+07	9.2200E-02	1.2500E+07	8.8237E-02	1.3000E+07	8.5000E-02
101	1.3500E+07	8.1574E-02	1.4000E+07	7.7700E-02	1.4500E+07	7.3974E-02	1.5000E+07	7.0000E-02	1.5500E+07	6.6404E-02
106	1.6000E+07	6.2700E-02	1.6500E+07	5.8807E-02	1.7000E+07	5.5200E-02	1.7500E+07	5.1681E-02	1.8000E+07	4.7800E-02
111	1.8500E+07	4.4000E-02	1.9000E+07	4.0200E-02	1.9500E+07	3.6385E-02	2.0000E+07	3.2200E-02		



ALUMINUM-27
(N,P)
NEUTRON CROSS SECTION
ENDF/B MAT NO. 6193
THRESHOLD
1.89610+ 6 EV
CROSS SECTION-BARNS (TIMES 10¹)
ENERGY-EV (TIMES 10⁷)

ALUMINUM-27 (N,ALPHA) NEUTRON CROSS SECTION ENDF/B MATERIAL NO. 6193

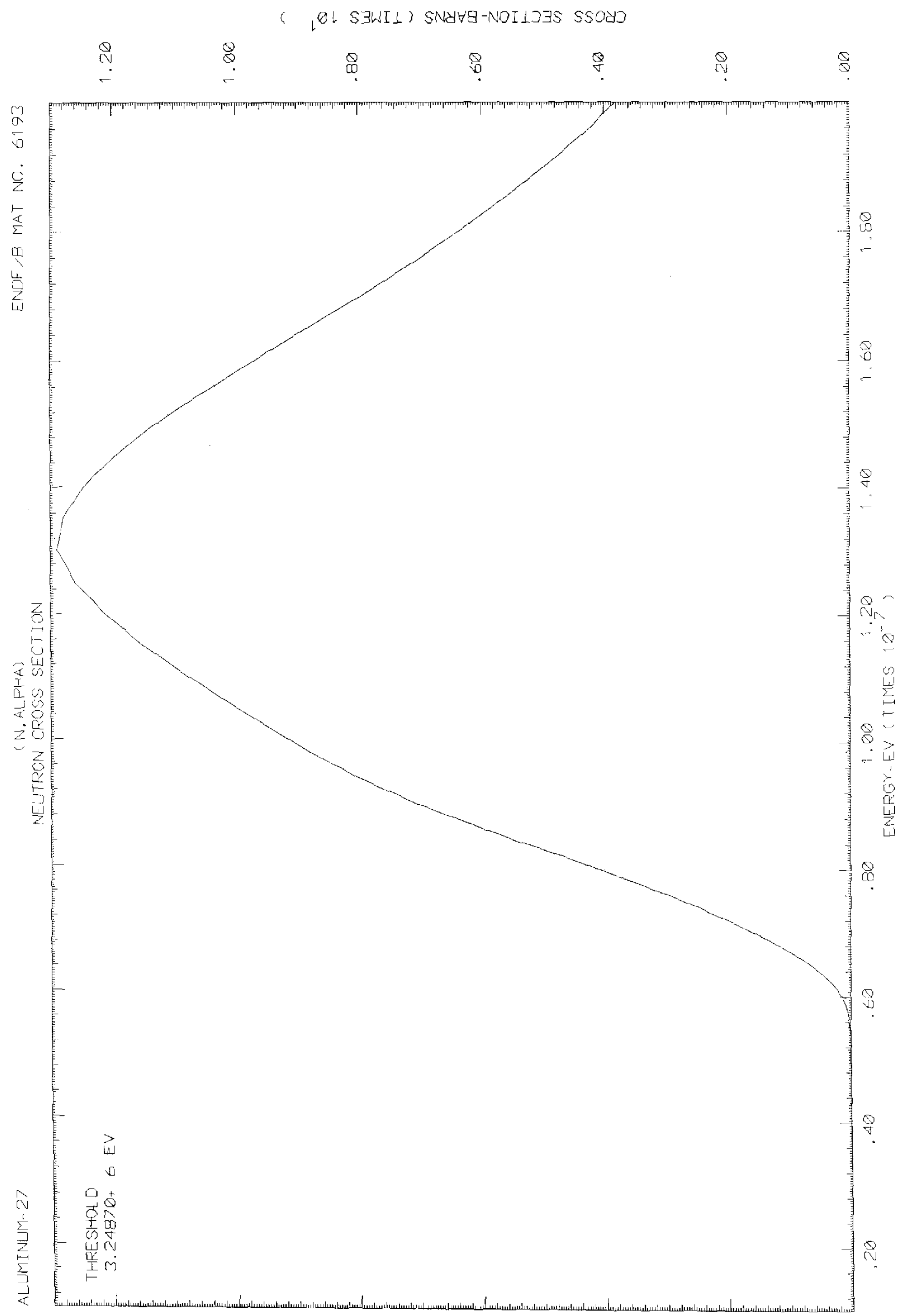
REACTION Q VALUE -3.1316E+06 EV

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION	RANGE	DESCRIPTION	RANGE	DESCRIPTION
1 TO 3	Y LINEAR IN X	3 TO 39	LN Y LINEAR IN X	39 TO 84	Y LINEAR IN X

NEUTRON CROSS SECTIONS

INDEX,	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	3.2487E+06	0.0000E+00	3.6000E+06	3.1600E-22	3.6500E+06	1.0140E-20	3.7000E+06	3.2536E-19	3.8000E+06	3.3500E-16
6	3.8500E+06	3.5617E-15	3.9000E+06	2.8838E-14	3.9500E+06	1.7782E-13	4.0000E+06	8.3500E-13	4.0500E+06	3.6743E-12
11	4.1000E+06	1.4222E-11	4.1500E+06	4.8419E-11	4.2000E+06	1.4500E-10	4.2500E+06	4.0965E-10	4.3000E+06	1.0758E-09
16	4.3500E+06	2.6263E-09	4.4000E+06	5.9600E-09	4.4500E+06	1.2931E-08	4.5000E+06	2.6786E-08	4.5500E+06	5.2969E-08
21	4.6000E+06	1.0000E-07	4.6500E+06	1.8320E-07	4.7000E+06	3.2520E-07	4.7500E+06	5.5930E-07	4.8000E+06	9.3200E-07
26	4.8500E+06	1.5162E-06	4.9000E+06	2.4107E-06	4.9500E+06	3.7462E-06	5.0000E+06	5.6900E-06	5.1000E+06	1.2464E-05
31	5.2000E+06	2.5500E-05	5.3000E+06	4.9242E-05	5.4000E+06	9.0200E-05	5.5000E+06	1.5803E-04	5.6000E+06	2.6500E-04
36	5.7000E+06	4.2700E-04	5.8000E+06	6.6700E-04	5.9000E+06	1.0100E-03	6.0000E+06	1.4900E-03	6.1000E+06	2.1400E-03
41	6.2000E+06	2.9900E-03	6.3000E+06	4.0000E-03	6.4000E+06	5.1400E-03	6.5000E+06	6.5400E-03	6.6000E+06	8.2000E-03
46	6.7000E+06	9.8700E-03	6.8000E+06	1.1800E-02	6.9000E+06	1.3700E-02	7.0000E+06	1.5900E-02	7.2000E+06	2.0100E-02
51	7.4000E+06	2.5000E-02	7.6000E+06	3.0000E-02	7.8000E+06	3.5600E-02	8.0000E+06	4.1300E-02	8.2000E+06	4.7100E-02
56	8.4000E+06	5.3300E-02	8.6000E+06	5.9200E-02	8.8000E+06	6.4900E-02	9.0000E+06	7.0200E-02	9.2000E+06	7.5100E-02
61	9.4000E+06	7.9700E-02	9.6000E+06	8.3800E-02	9.8000E+06	8.7700E-02	1.0000E+07	9.1200E-02	1.0500E+07	9.9612E-02
66	1.1000E+07	1.0750E-01	1.1500E+07	1.1493E-01	1.2000E+07	1.2120E-01	1.2500E+07	1.2604E-01	1.3000E+07	1.2880E-01
71	1.3500E+07	1.2794E-01	1.4000E+07	1.2470E-01	1.4500E+07	1.1936E-01	1.5000E+07	1.1290E-01	1.5500E+07	1.0521E-01
76	1.6000E+07	9.7000E-02	1.6500E+07	8.8406E-02	1.7000E+07	7.9400E-02	1.7500E+07	7.1187E-02	1.8000E+07	6.3700E-02
81	1.8500E+07	5.6537E-02	1.9000E+07	4.9800E-02	1.9500E+07	4.3437E-02	2.0000E+07	3.8000E-02		


ALUMINUM-27
THRESHOLD
3.24870+ 6 EV
(N,ALPHA)
NEUTRON CROSS SECTION
ENDF/B MAT NO. 6193
ENERGY-EV
CROSS SECTION-BARNS

Evaluation of the $^{32}S(n,p)^{32}P$ Reaction

for ENDF/B-III

N.D. Dudley and Robert Kennerley

Argonne National Laboratory

The literature examined in this review includes all references in CINDA 71 and its Supplements. Four experiments have reported $^{32}S(n,p)$ cross sections near the reaction threshold of 1.6 MeV. All used the activation technique and measured relative to a flux monitor. The beta counting of the sulphur pellets appears to be the weakest portion of these measurements because of self absorption and self-scattering of beta particles in the relatively thick sulphur targets.

The four data sets are shown in Fig. 1. Klema and Hanson measured relative to a uranium fission chamber. Neither the isotopic composition nor the uranium cross sections are stated so renormalization of their results is not possible. Lüscher measured relative cross sections and normalized to Klema and Hanson. Hurlimann and Huber calibrated a Hornyack button relative to H(n,p) then measured $^{32}S(n,p)$ relative to the calibrated Hornyack detector. Allen et al. measured relative to a $^{238}U(n,f)$ chamber and

$^{32}S(n,p)^{32}P$
0-5 MeV

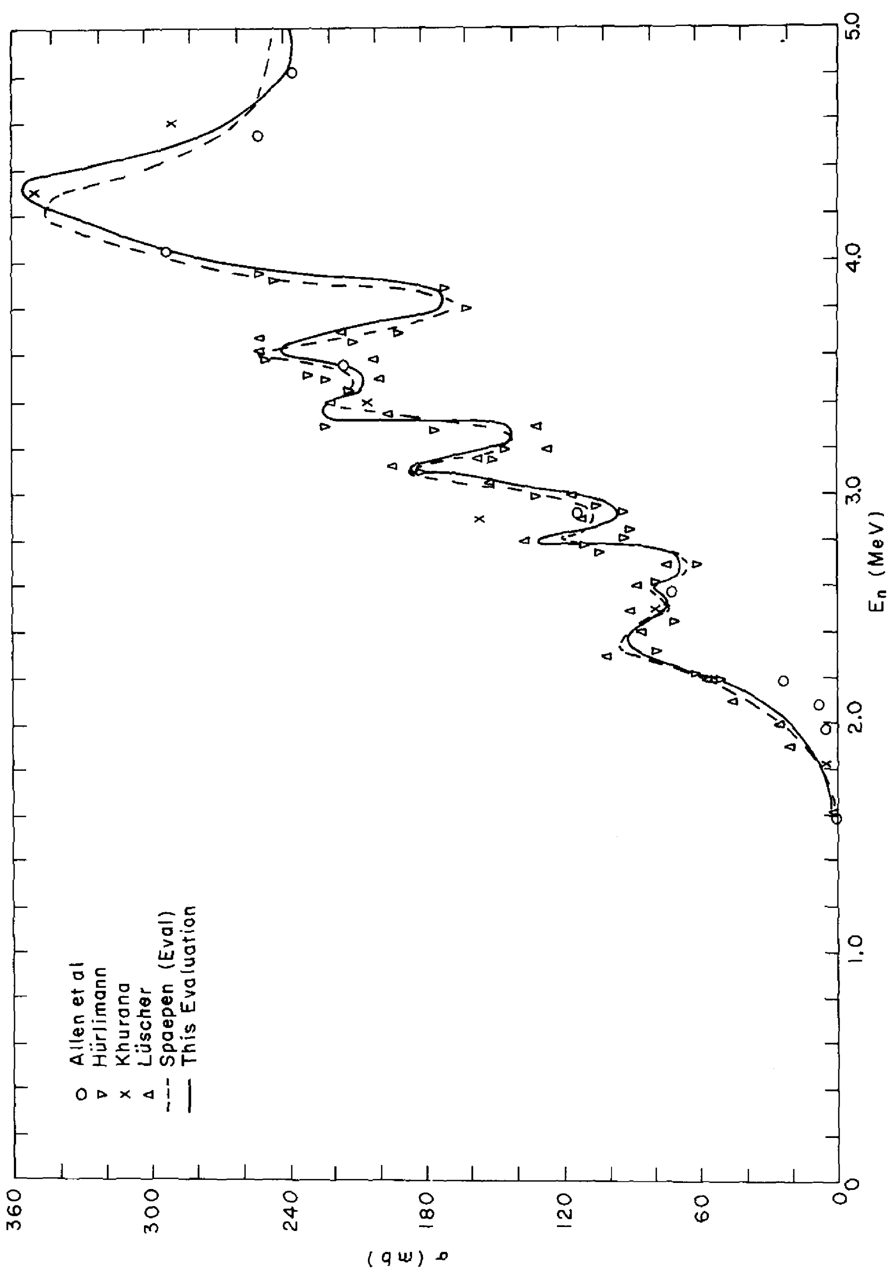
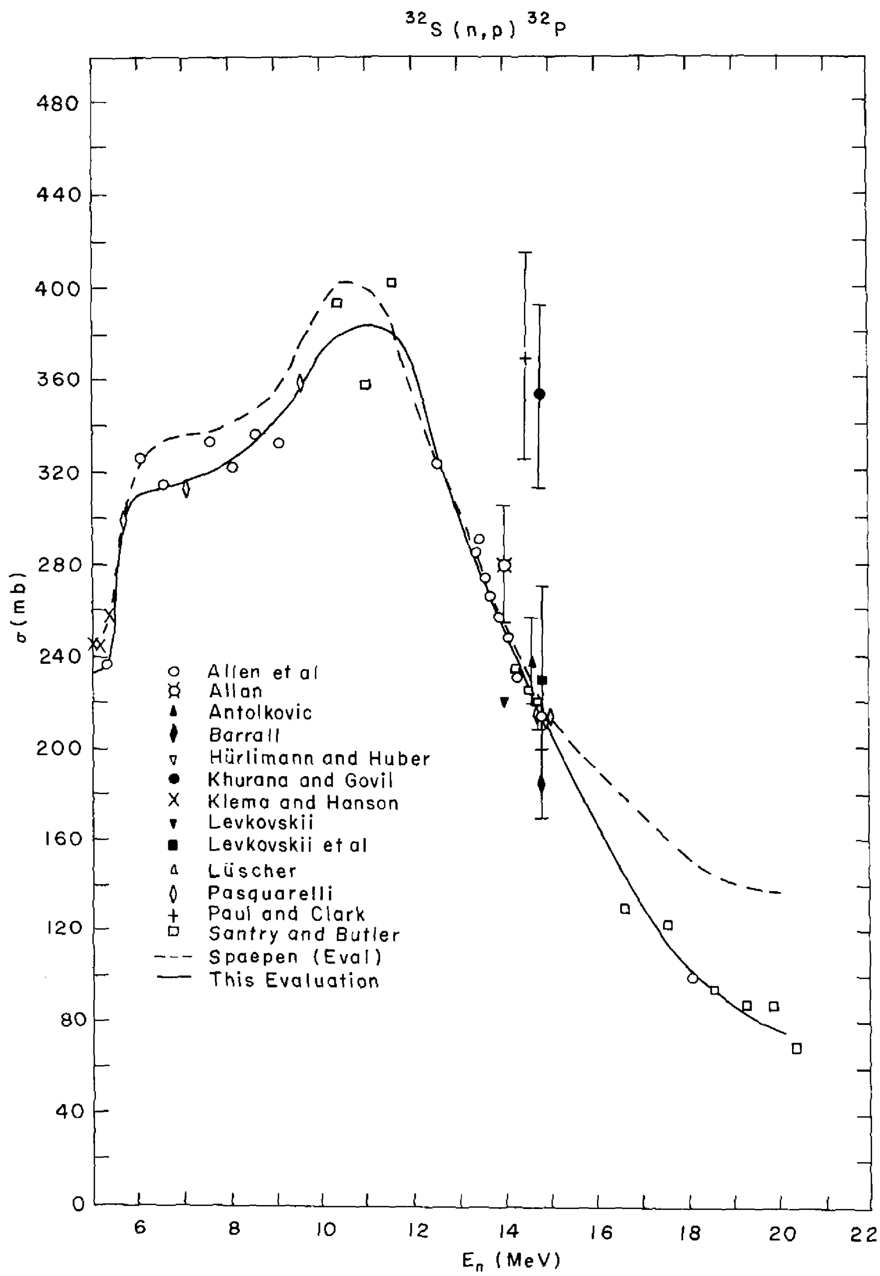


Figure 1

we have renormalized their data to the ENDF/B-III $^{238}U(n,f)$ cross sections. The structural detail as seen both by Lüscher and Hurlimann-Huber is well reproduced with the exception of a 20-50 keV difference in the neutron energy scale. We have chosen to increase the neutron energy scale of Hurlimann-Huber by 20 keV between 2.2 to 2.9 MeV and 50 keV for data greater than 3.0 MeV although this is not shown on the data plotted in Fig. 1. With the exception of the 2.25 and 2.55 MeV energy region, the agreement between the four experiments is reasonably good.

After renormalization of the Allen et al. data, good agreement is obtained with Klema and Hanson from 3.4 to 5.8 MeV. From 5.8 to 9.6 MeV data are only available from Allen. Between 10.4 to 11.6 Santry and Butler have data relative to the Allen data at lower energy. We have renormalized the Santry and Butler values relative to the renormalized Allen data. From 13 to 15 MeV, Allen measured the cross section absolutely by the associated alpha particle technique. Santry and Butler measured relative to Allen from 12.5 to 20.3 MeV by normalization at 14.50 MeV. Both measurements seem acceptable without any renormalization.

Eight individual measurements are reported between 14.0 and 14.8 MeV. These data have large scatter but, in general, are consistent (on the average) with both Allen and Santry and Butler. These data are shown in Fig. 2 with error bars attached. Above 15 MeV our evaluation follows the Santry and Butler data.



$^{32}S(n,p)^{32}P$
σ (mb)
E_n (MeV)
Allen et al
Allan
Antolkovic
Barrall
Hürlimann and Huber
Khurana and Govil
Klema and Hanson
Levkovskii
Levkovskii et al
Lüscher
Pasquarelli
Paul and Clark
Santry and Butler
Spaepen (Eval)
This Evaluation

Figure 2

Because $^{32}S(n,p)$ has been extensively used as a cross section reference reaction, we feel additional measurements from threshold to 20 MeV are required. The cross section situation for $^{32}S(n,p)$ is not satisfactory for its use as a standard. Our evaluation consists of a "best" curve and is shown as the solid line in Fig. 1 and 2. An evaluation by J. Spaepen is also shown and is similar to ours up to 15 MeV.

References

1. D.L. Allan, Nuc. Phys. 24, 274-299 (1961).

2. L. Allen, Jr., W. A. Biggers, R.J. Prestwood, and R.K. Smith, Phys. Rev. 107(5) 1363-1366 (1957).

3. B. Antolkovic, Nuc. Phys. 44, 123-129 (1963).

4. R.C. Barrall, M. Silbergeld, and D. G. Gardner, Nuc. Phys. A138, 387-391 (1969).

5. T. Hurlimann and P. Huber, Helvetica Physica Acta 23, 561-566 (1950).

6. C.S. Khurana and I. M. Govil, Nuc. Phys. 69, 153-157 (1965).

7. E.D. Klema and A. O. Hanson, Phys. Rev. 73(2), 106-110 (1948).

8. V.N. Levkovskii, Soviet Physics JETP 18(1), 213-217 (1964).

9. V. Levkovskii, G.E. Kovel'Skaya, G.P. Vinitskaya, V. Sm. Stepanov, and V. V. Sokoz'skii, Soviet Journal of Nuclear Physics 8(1), 4-5 (1969).

10. E. Lüscher, R. Ricamo, P. Scherrer, and W. Zunt, Helvetica Physica Acta 23, 561-566 (1950).

11. A. Pasquarelli, Nuc. Phys. A93, 218-222 (1967).

12. E.B. Paul and R. L. Clarke, Canadian Journal of Physics 31, 267-277 (1952).

13. D.C. Santry and J. P. Butler, Canadian Journal of Chemistry 41, 123-133 (1963).

14. J. Spaepen, Private Communication (1972).

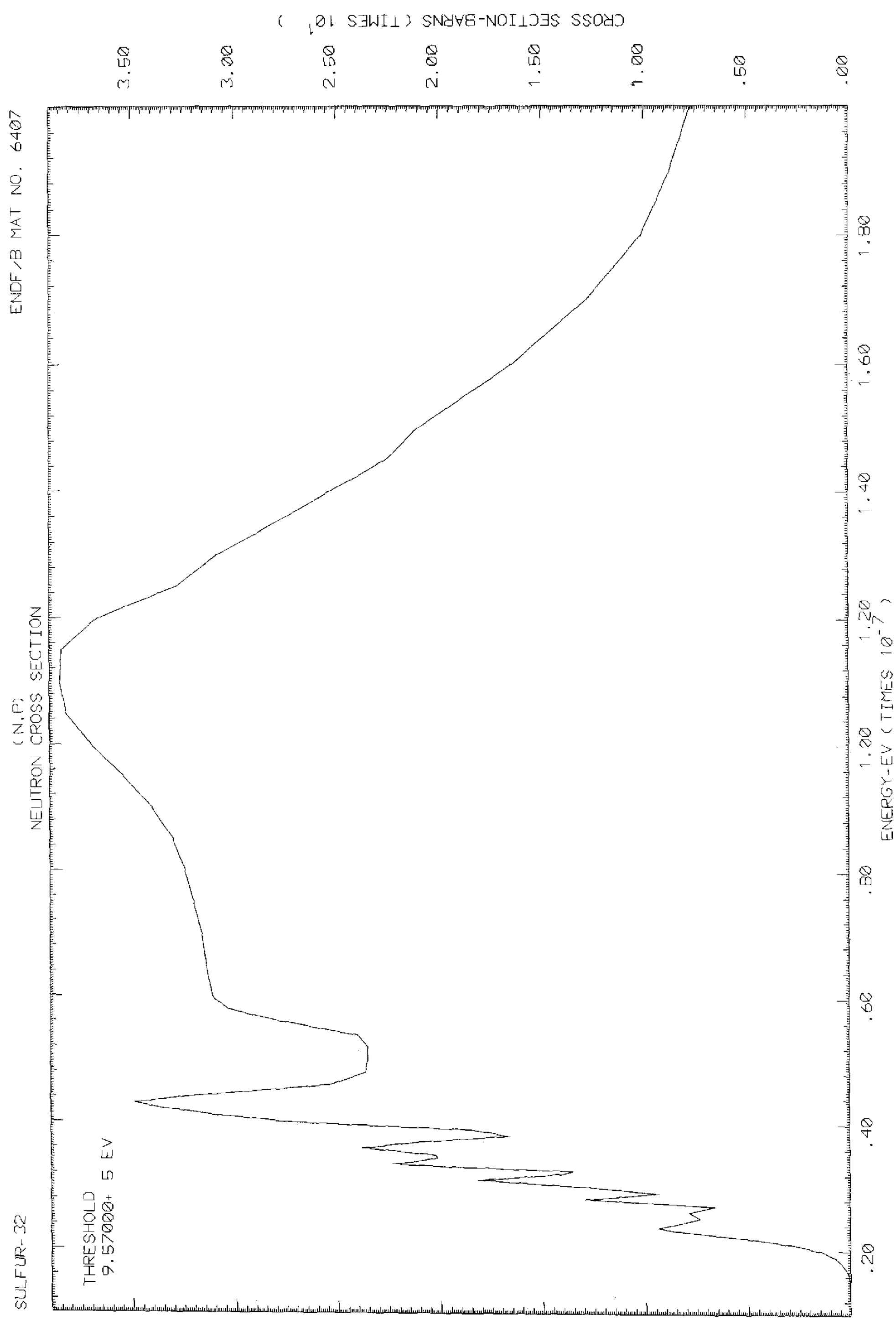
REACTION Q VALUE -9.2750E+05 EV

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION
1 TO 71	Y LINEAR IN X

NEUTRON CROSS SECTIONS

INDEX.	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	9.5700E+05	0.0000E+00	1.0000E+06	1.2800E-05	1.1000E+06	2.5000E-05	1.2000E+06	5.0000E-05	1.3000E+06	1.1200E-04
6	1.4900E+06	2.3000E-04	1.5000E+06	4.7000E-04	1.6000E+06	9.5000E-04	1.7000E+06	1.8000E-03	1.8000E+06	4.0000E-03
11	1.9000E+06	7.8000E-03	2.0000E+06	1.4500E-02	2.1000E+06	2.9500E-02	2.2000E+06	5.2000E-02	2.3000E+06	8.4000E-02
16	2.3500E+06	9.4000E-02	2.4000E+06	8.6500E-02	2.5000E+06	7.3000E-02	2.6000E+06	7.9000E-02	2.7000E+06	6.6000E-02
21	2.8000E+06	1.2900E-01	2.9000E+06	9.3000E-02	3.0000E+06	1.2900E-01	3.1000E+06	1.8200E-01	3.2000E+06	1.4100E-01
26	3.2500E+06	1.3500E-01	3.3000E+06	1.8800E-01	3.3500E+06	2.2300E-01	3.4000E+06	2.1000E-01	3.4500E+06	2.0100E-01
31	3.5000E+06	2.0200E-01	3.6000E+06	2.3800E-01	3.7000E+06	2.1000E-01	3.8000E+06	1.6600E-01	3.9000E+06	1.8500E-01
36	4.0000E+06	2.7000E-01	4.1000E+06	3.0500E-01	4.2000E+06	3.3400E-01	4.3000E+06	3.4900E-01	4.4000E+06	3.2400E-01
41	4.6000E+06	2.5400E-01	4.8000E+06	2.3600E-01	5.0000E+06	2.3500E-01	5.2000E+06	2.3500E-01	5.4000E+06	2.4000E-01
46	5.6000E+06	2.7700E-01	5.8000E+06	3.0300E-01	6.0000E+06	3.1100E-01	6.5000E+06	3.1400E-01	7.0000E+06	3.1600E-01
51	7.5000E+06	3.2000E-01	8.0000E+06	3.2400E-01	8.5000E+06	3.3000E-01	9.0000E+06	3.4000E-01	9.5000E+06	3.5400E-01
56	1.0000E+07	3.7000E-01	1.0500E+07	3.8200E-01	1.1000E+07	3.8500E-01	1.1500E+07	3.8400E-01	1.2000E+07	3.6600E-01
61	1.2500E+07	3.2800E-01	1.3000E+07	3.0600E-01	1.3500E+07	2.8000E-01	1.4000E+07	2.5300E-01	1.4500E+07	2.2500E-01
66	1.5000E+07	2.1000E-01	1.6000E+07	1.6400E-01	1.7000E+07	1.2700E-01	1.8000E+07	1.0100E-01	1.9000E+07	8.7000E-02
71	2.0000E+07	7.7000E-02								


SULFUR-32
(N,P)
NEUTRON CROSS SECTION
ENDF/B MAT NO. 6407
THRESHOLD
9.57000+ 5 EV
CROSS SECTION-BARNS (TIMES 10^-1)
ENERGY-EV (TIMES 10^7)
.00
.50
1.00
1.50
2.00
2.50
3.00
3.50
.20
.40
.60
.80
1.00
1.20
1.40
1.60
1.80

Evaluation of the $^{45}Sc(n,\gamma)^{46}Sc$ Reaction*

for ENDF/B-IV

B.A. Magurno and S.F. Mughabghab

National Neutron Cross Section Center

Brookhaven National Laboratory

Because of the importance of ^{45}Sc in dosimetry applications and its use as a filter to produce a "monoenergetic" neutron beam at 2.0 keV an accurate knowledge of the cross sections is required. In another study(1) an analysis and evaluation of the total cross section in the thermal and resonance region was presented. That study is extended here to include the capture cross section from the thermal region to 20 MeV.

The only capture cross section data sets (other than thermal) available at the time of this evaluation were those of Romanov(2) (average cross sections as function of energy) Perkin(3), Csikai(4), and Booth.(5) This lack of data caused almost complete dependence on a multilevel Breit-Wigner calculation using the code RESEND(6) for the thermal and resonance region cross section evaluation.

As a starting point, the resonance parameters recommended in BNL-325 (1973) were adopted. Since the spin and parity of the ground state of the target nucleus are $7/2^-$, s-wave neutron capture by Sc-45 forms compound states with spins and parities 3^-

*Research supported by U.S. Energy Research and Development Administration.

and 4^-. The spins of the resonances below 10 keV were not determined. In addition, thermal capture γ ray spectra measurements of Bolotin[7] and Delang *et al.*[8] give some, but inconclusive, indication that the spin of the bound level is possibly 3. This is based on the observation of a primary transition to a low lying state at 142 keV with spin and parity 1^- and the lack of transitions to several low lying states with possible spin and parity of 5+. It must be pointed out that at the start of the evaluation, thermal neutron polarization data which is important in shedding light on the coherent and incoherent cross sections and the spin of the bound level, were not available.

The total cross section in the energy range 3-10 keV was calculated and compared with the experimental data. The spin of the resonances at 3.24, 4.27, 6.59, 7.92, 8.90, 11.7 keV were found to be 3,4,3,4,3,4 respectively. With such a choice for the spins, several attempts were made to reproduce the minimum at 2.0 keV on the assumption that the spin of the bound level is 3. However, the best fit in the region of the minimum in the total cross section was achieved by adopting a spin 4 for the bound level.

With the aid of the resonance parameters determined from σ_t the partial cross sections can be calculated. Of particular interest is the comparison of the calculated thermal cross sections with the experimental cross section recommended in BNL-325[9] and more recently reported results of Dilg.[10] As can be seen (Table I) the results are in excellent agreement.

Table I

	0.0253 eV		18.8 eV	
	BNL-325	ENDF/B-IV Evaluation	Dilg.	ENDF/B-IV Evaluation
σ_t(b)	50.5 ± 1.0	50.6	22.03 ± 0.25	21.7
σ_γ(b)	26.5 ± 1.0	26.9	(1.01)	0.9
σ_s(b)	24 ± 2	23.7	21.0	20.8

The average data set of Romanov[2] (to 40 keV) and the Booth[5] datum (20 keV) were not used since they fell inside the resolved energy region. The data of Perkin[3] (.15-15 MeV) and Csikai[4] (15 MeV) were used as guides for extending the capture cross section from 0.1 MeV (upper end of the resolved energy region) to 20 MeV. The evaluation is a smooth curve approximating the data of Perkin and Csikai.

References

1. B.A. Magurno and S.F. Mughabghab, Nucl. Sci. and Tech. Conf. (To Be Published) (March 1975).

2. S.A. Romanov and F.L. Shapiro, J. Yad. F12, 229 (1965).

3. J.L. Perkin, J. Nuc. Energy 17, 349 (1963).

4. J. Csikai, G. Peto, M. Buczko, Z. Miligy and N.A. Eissa, Nucl. Phys. A95, 229(1966).

5. R. Booth, W.P. Ball and M.H. MacGregor, Phys. Rev. 112, 226 (1958).

6. O. Ozer, RESEND, BNL 17134, Brookhaven National Laboratory.

7. H.H. Bolotin, Phys. Rev. 168, 1317 (1968).

8. W. Delang, P. Gottel, and H. Seyfarth, Contribution A56, Conference on Nuclear Structure Study with Neutron, (Budapest 1972) p.112.

9. S.F. Mughabghab, and D.I. Garber, BNL 325, Neutron Cross Sections, Vol. 1 (1973).

10. W. Dilg, Z. Naturforsch 29a, 1750 (1974).

SCANDIUM-45

ENDF/B MATERIAL NO. 6415
RESONANCE DATA
RESONANCE PARAMETERS

```
ISOTOPE-------------------------SCANDIUM-45
FRACTIONAL ABUNDANCE----------- 1.0000E+00
NUMBER OF ENERGY RANGES------            1

ENERGY RANGE NUMBER-----------           1
LOWER ENERGY LIMIT (EV)-------- 1.0000E-05
UPPER ENERGY LIMIT (EV)-------- 1.0590E+05
NUCLEAR SPIN------------------- 3.5000E+00
SPIN SCATTERING LENGTH (A+)---- 5.1000E-01
NUMBER OF L STATES-----------            2
```

RESOLVED MULTILEVEL BREIT-WIGNER PARAMETERS

```
L VALUE------------------------          0
NUMBER OF RESONANCES----------          57
SPIN SCATTERING LENGTH (A-)---- 0.0000E+00
```

INDEX	ENERGY (EV)	J VALUE	RESONANCE WIDTHS (EV) TOTAL	NEUTRON	RADIATION	FISSION
1	-2.7000E+02	4.0000E+00	3.4093E+01	3.3714E+01	3.7900E-01	0.0000E+00
2	3.2400E+03	3.0000E+00	7.0300E+01	7.0000E+01	3.0000E-01	0.0000E+00
3	4.2700E+03	4.0000E+00	3.0035E+02	3.0000E+02	3.5000E-01	0.0000E+00
4	6.5900E+03	3.0000E+00	7.4500E+01	7.3000E+01	1.5000E+00	0.0000E+00
5	7.9200E+03	4.0000E+00	1.6150E+02	1.6000E+02	1.5000E+00	0.0000E+00
6	8.9000E+03	3.0000E+00	2.6150E+02	2.6000E+02	1.5000E+00	0.0000E+00
7	1.1700E+04	4.0000E+00	1.4150E+02	1.4000E+02	1.5000E+00	0.0000E+00
8	1.9170E+04	4.0000E+00	6.1500E+01	6.0000E+01	1.5000E+00	0.0000E+00
9	2.0800E+04	4.0000E+00	6.1500E+01	6.0000E+01	1.5000E+00	0.0000E+00
10	2.0950E+04	3.0000E+00	8.0150E+02	8.0000E+02	1.5000E+00	0.0000E+00
11	2.4180E+04	3.0000E+00	6.1500E+01	6.0000E+01	1.5000E+00	0.0000E+00
12	2.4480E+04	4.0000E+00	6.1500E+01	6.0000E+01	1.5000E+00	0.0000E+00
13	2.7120E+04	4.0000E+00	9.1460E+01	8.9960E+01	1.5000E+00	0.0000E+00
14	2.8120E+04	3.0000E+00	1.1160E+02	1.1010E+02	1.5000E+00	0.0000E+00
15	2.9850E+04	4.0000E+00	1.0150E+02	1.0000E+02	1.5000E+00	0.0000E+00
16	3.2400E+04	3.0000E+00	5.7150E+02	5.7000E+02	1.5000E+00	0.0000E+00
17	3.4000E+04	3.0000E+00	1.9120E+02	1.8970E+02	1.5000E+00	0.0000E+00
18	3.5300E+04	4.0000E+00	2.8150E+02	2.8000E+02	1.5000E+00	0.0000E+00
19	4.0370E+04	4.0000E+00	1.3130E+02	1.2980E+02	1.5000E+00	0.0000E+00
20	4.0770E+04	3.0000E+00	1.0150E+02	1.0000E+02	1.5000E+00	0.0000E+00
21	4.1150E+04	4.0000E+00	1.1170E+02	1.1020E+02	1.5000E+00	0.0000E+00
22	4.3350E+04	4.0000E+00	1.7040E+02	1.6890E+02	1.5000E+00	0.0000E+00
23	4.6150E+04	3.0000E+00	4.8150E+02	4.8000E+02	1.5000E+00	0.0000E+00
24	4.7600E+04	3.0000E+00	1.8150E+02	1.8000E+02	1.5000E+00	0.0000E+00
25	4.9170E+04	4.0000E+00	1.6150E+02	1.6000E+02	1.5000E+00	0.0000E+00
26	5.1160E+04	4.0000E+00	8.4780E+02	8.4630E+02	1.5000E+00	0.0000E+00
27	5.2180E+04	3.0000E+00	1.0550E+02	1.0400E+02	1.5000E+00	0.0000E+00
28	5.4830E+04	3.0000E+00	2.2210E+02	2.2060E+02	1.5000E+00	0.0000E+00
29	5.7680E+04	3.0000E+00	2.1750E+02	2.1600E+02	1.5000E+00	0.0000E+00
30	5.8770E+04	3.0000E+00	1.6610E+02	1.6460E+02	1.5000E+00	0.0000E+00
31	6.1840E+04	4.0000E+00	5.2510E+02	5.2360E+02	1.5000E+00	0.0000E+00
32	6.2540E+04	3.0000E+00	5.6610E+02	5.6460E+02	1.5000E+00	0.0000E+00
33	6.5940E+04	4.0000E+00	1.0416E+03	1.0401E+03	1.5000E+00	0.0000E+00
34	7.0110E+04	3.0000E+00	1.6931E+03	1.6916E+03	1.5000E+00	0.0000E+00
35	7.1760E+04	4.0000E+00	4.1040E+02	4.0890E+02	1.5000E+00	0.0000E+00
36	7.3180E+04	3.0000E+00	3.5240E+02	3.5090E+02	1.5000E+00	0.0000E+00
37	7.4900E+04	3.0000E+00	1.5120E+02	1.4970E+02	1.5000E+00	0.0000E+00
38	7.7150E+04	4.0000E+00	2.5040E+02	2.4890E+02	1.5000E+00	0.0000E+00

39	7,7550E+04	3,0000E+00	6,0150E+02	6,0000E+02	1,5000E+00	0,0000E+00
40	7,7850E+04	4,0000E+00	1,5090E+02	1,4940E+02	1,5000E+00	0,0000E+00
41	7,9000E+04	3,0000E+00	2,0150E+02	2,0000E+02	1,5000E+00	0,0000E+00
42	7,9800E+04	3,0000E+00	2,8019E+03	2,8004E+03	1,5000E+00	0,0000E+00
43	8,1100E+04	4,0000E+00	6,0150E+02	6,0000E+02	1,5000E+00	0,0000E+00
44	8,3000E+04	4,0000E+00	1,5090E+02	1,4940E+02	1,5000E+00	0,0000E+00
45	8,5600E+04	4,0000E+00	8,5140E+02	8,4990E+02	1,5000E+00	0,0000E+00
46	8,6000E+04	3,0000E+00	6,5190E+02	6,5040E+02	1,5000E+00	0,0000E+00
47	8,8600E+04	3,0000E+00	5,5130E+02	5,4980E+02	1,5000E+00	0,0000E+00
48	9,0200E+04	4,0000E+00	1,2150E+02	1,2000E+02	1,5000E+00	0,0000E+00
49	9,1700E+04	3,0000E+00	5,5130E+02	5,4980E+02	1,5000E+00	0,0000E+00
50	9,4400E+04	3,0000E+00	8,0160E+02	8,0010E+02	1,5000E+00	0,0000E+00
51	9,9800E+04	3,0000E+00	2,0015E+03	2,0003E+03	1,5000E+00	0,0000E+00
52	1,0070E+05	4,0000E+00	3,0110E+02	2,9960E+02	1,5000E+00	0,0000E+00
53	1,0100E+05	3,0000E+00	4,0150E+02	4,0000E+02	1,5000E+00	0,0000E+00
54	1,0210E+05	4,0000E+00	3,0110E+02	2,9960E+02	1,5000E+00	0,0000E+00
55	1,0230E+05	3,0000E+00	3,5130E+02	3,4980E+02	1,5000E+00	0,0000E+00
56	1,0400E+05	4,0000E+00	1,5170E+02	1,5020E+02	1,5000E+00	0,0000E+00
57	1,0570E+05	4,0000E+00	1,5170E+02	1,5020E+02	1,5000E+00	0,0000E+00

L VALUE------------------------ 1
NUMBER OF RESONANCES---------- 2
SPIN SCATTERING LENGTH (A-)-- 0,0000E+00

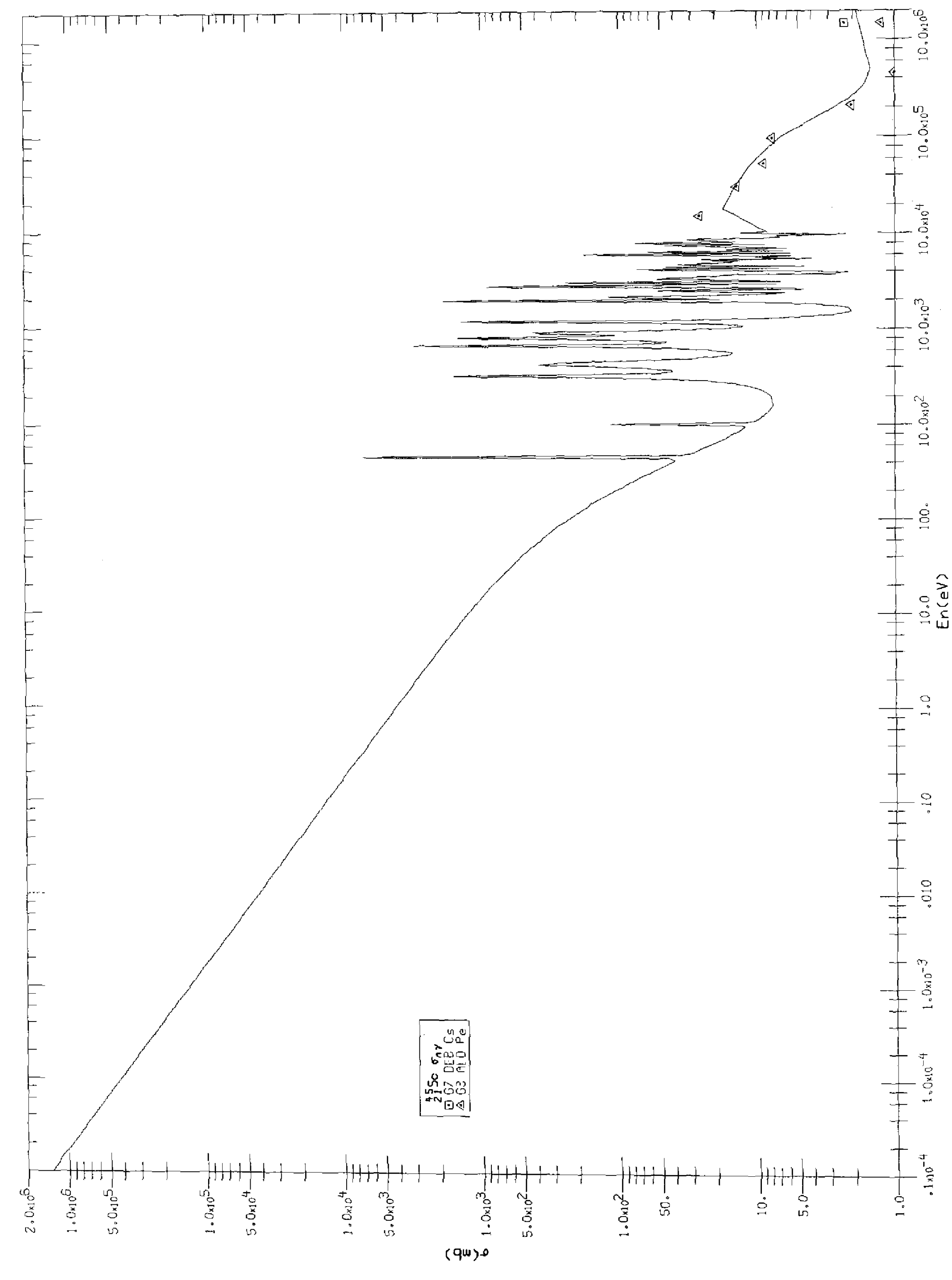
				RESONANCE WIDTHS (EV)		
INDEX	ENERGY (EV)	J VALUE	TOTAL	NEUTRON	RADIATION	FISSION
1	4,5500E+02	4,0000E+00	3,0760E-01	7,6000E-03	3,0000E-01	0,0000E+00
2	1,0100E+03	3,0000E+00	3,2200E-01	2,2000E-02	3,0000E-01	0,0000E+00

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION	RANGE	DESCRIPTION
1 TO 3	Y LINEAR IN X	3 TO 23	LN Y LINEAR IN LN X

NEUTRON CROSS SECTIONS

INDEX,	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	1,0000E-05	0,0000E+00	1,0590E+05	0.0000E+00	1.0590E+05	2.1300E-02	1.7943E+05	1.7559E-02	3,0400E+05	1.4200E-02
6	3,7448E+05	1.2921E-02	4,6130E+05	1.1611E-02	5,6825E+05	1,0238E-02	7.0000E+05	8.8000E-03	8,0000E+05	7,9000E-03
11	9,0000E+05	7,2000E-03	1,0000E+06	6,5000E-03	2,3300E+06	2,2000E-03	2,6103E+06	1.9727E-03	2,9242E+06	1,8047E-03
16	3,2760E+06	1,6833E-03	3,6700E+06	1,6000E-03	4,2837E+06	1,5341E-03	5,0000E+06	1.5000E-03	6,3246E+06	1,4750E-03
21	8,0000E+06	1,5000E-03	1,4700E+07	1,8000E-03	2,0000E+07	1,9000E-03				



En(eV)
σ(mb)
.1x10⁻⁴
1.0x10⁻⁴
1.0x10⁻³
.010
.10
1.0
10.0
100.
10.0x10²
10.0x10³
10.0x10⁴
10.0x10⁵
10.0x10⁶
2.0x10⁶
1.0x10⁶
5.0x10⁵
1.0x10⁵
5.0x10⁴
1.0x10⁴
5.0x10³
1.0x10³
5.0x10²
1.0x10²
50.
10.
5.0
1.0

REFERENCES FOR EXPERIMENTAL DATA

$^{45}Sc(n,\gamma)$

Yr.	Lab	Author	References
67	DEC	Csikai, et al.	Nuc. Phys./A 95, 229 (1967)
65	LEB	Romanov, et al.	Yad. Fiz. 1, 229 (1965)
63	ALD	Perkin	J. Nuc. En. 17, 349 (1963)
58	LRL	Booth, et al.	Phys. Rev. 112, 226 (1958)

An Evaluation of the (n,p) and (n,np) Reactions of the Isotopes of Titanium for ENDF/B-IV

B.A. Magurno

NNCSC

Brookhaven National Laboratory

Threshold detectors generally use elemental titanium rather than isotopically enriched samples necessitating the evaluation of all the (n,p), (n,np), (n,pn) and (n,d) reactions of the major contributing isotopes separately. ^{49}Ti and ^{50}Ti will not be dealt with here since they are both approximately 5% abundant and have small cross sections. The (n,np), (n,pn) and (n,d) reactions will be lumped together and hereafter called (n,np). The energy range will be divided into three regions. Region I is that of threshold to 7 MeV. Region II, 7 to 12 MeV and Region III, 12-20 MeV.

^{46}Ti(n,p)^{46}Sc.

The ^{46}Ti(n,p)^{46}Sc reaction is useful as a dosimetry material because of its long half life and simple mode of decay (i.e. 83.8 days, 0.89 MeV γ). This cross section is considered one of the primary reaction necessary in the ILRR program.(1) Until recently the only data sets available in Region I were those of Ghorai(2) and Lukic.(3) Ghorai's data was taken on the 3-MeV Dynamitron at Auburn University and measured relative to ^{27}Al (n,p)^{27}Mg of Grundl.(4) Lukic, on the 4-MeV Van De Graaff of the University of Florida, measured relative to ^{56}Fe(n,p)^{56}Mn(5),

$^{27}Al(n,\alpha)^{24}Na$[6] and $^{58}Ni(n,p)^{58}Co$.[7] These data, however, where widely scattered and had cross section errors of the order of 20%. Smith[8] has since measured the cross section from 3-6 MeV on the ANL Fast Neutron Generator with accuracies of about 6%, using enriched ^{235}U in a fission chamber for $E_n \lesssim 3$ MeV and enriched ^{238}U for higher energies. This data set alone was used as input for the evaluation from 3-6 MeV. From threshold (1.62 MeV) to 3 MeV (no data available) Slavic[9] from Knolls Atomic Power Laboratory supplies "guidance" with model calculations.

Region II has no available data. Smith of ANL, however, is extending the measurement (above) to 10 MeV. If these cross sections being measured are higher than the present evaluation, they may help to solve the discrepancy between ^{235}U fission spectrum averaged cross section calculated from above (10.2 mb) and the presently, accepted integral cross section[10] (12.3 mb).

Region III (12-20 MeV) has several data sets measured as a function of energy. Liskien[1] accounted for the possibility of competing reactions in the text (i.e. $^{47}Ti(n,np)^{46}Sc$) but apparently did not correct the data. Bormann's[12] cross section measurements are available but very little information regarding the experiment accompany the results. The best data available, using isotopically enriched samples and correcting for completing reactions are those of Pai.[13] The six 14 MeV experiments (Table 1) range from 203 mb to ∿ 520 mb making their contribution to the evaluation minimal.

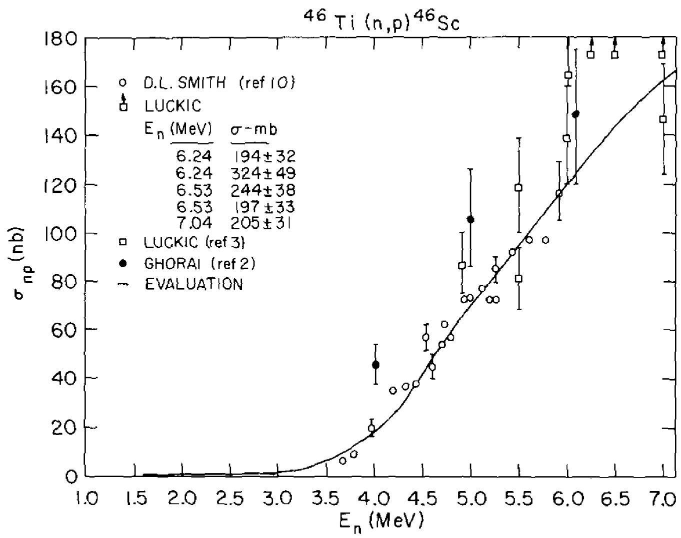


Figure 1

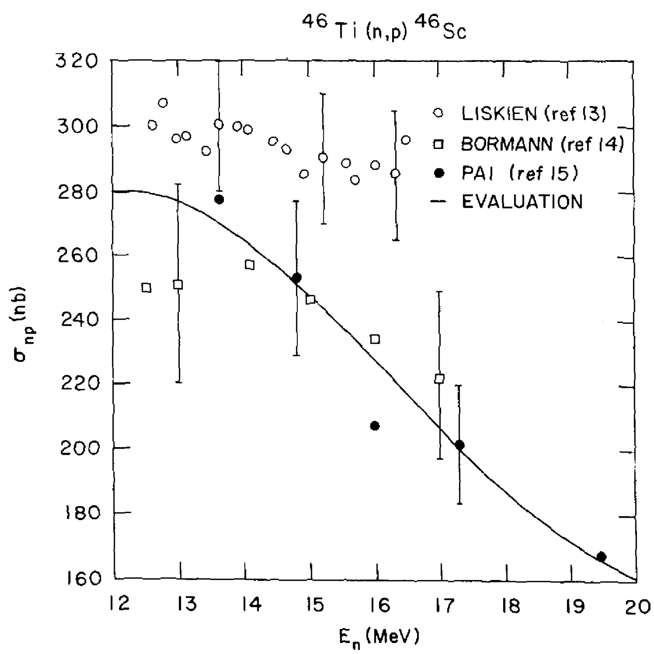


Figure 2

The model calculation of Slavic, the data of Smith, Pai (heavily weighted), Liskien, and Bormann were used as input to SPLINE[14], a cubic spline[15] fitting program which generated the evaluated $^{46}Ti(n,p)^{46}Sc$ ENDF/B-IV cross section curve.

<u>$^{47}Ti,(n,p)^{47}Sc$, $^{47}Ti(n,np)^{46}Sc$.</u>

$^{47}Ti(n,p)$ is an exoergic reaction with an apparent threshold of $\sim$ 0.5 MeV. It is considered a secondary reaction in the ILRR program.[1] The data by Smith[8] with that of Armitage[16] were the determining factors in the evaluation of Region I. As in ^{46}Ti, Ghorai's data were deemed too high. The data of Gonzales[17] seem to be of different shape and magnitude compared to the other experiments (see curve-3) and were ignored for this evaluation.

As in $^{46}Ti(n,p)^{46}Sc$ Region II has no data available but measurements by D.L. Smith are underway.

Region III has only one data set as a function of energy, that of Pai.[13] The 14 MeV measurements of Cross,[18] Allan[19] and Hillman[20] are in general agreement with Pai, while those of Levkovski[21] and Poularikis[22] are high.

The data of Smith, Armitage, Ghorai, Pai, Hillman, Allan, Cross, were used as input to SPLINE and the cross section curve was generated.

$^{47}Ti(n,np)^{46}Sc$ was merely a connection of points as supplied by Pai since this is the only information available.

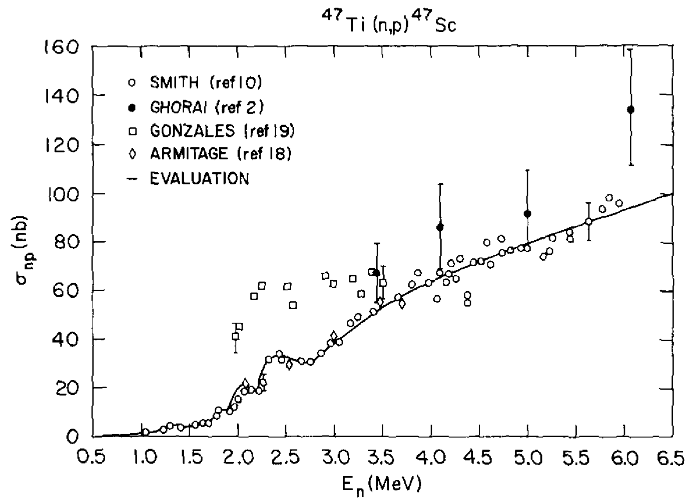


Figure 3

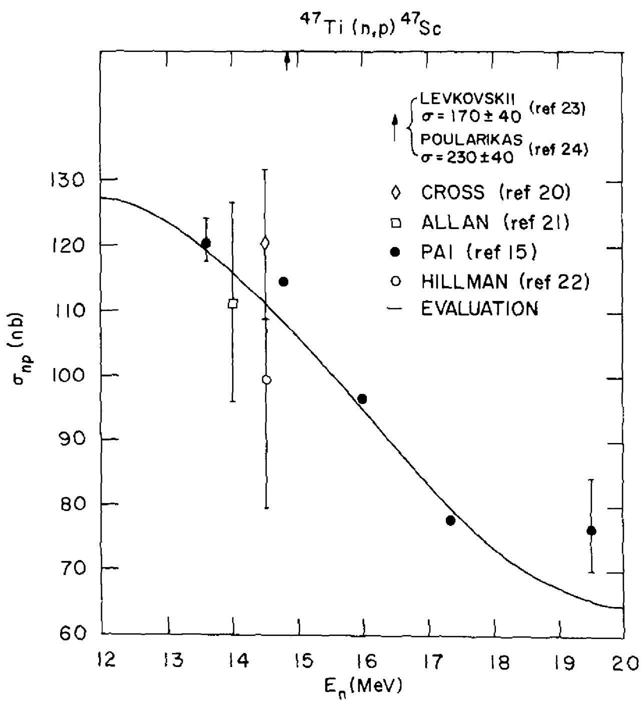


Figure 4

$^{48}Ti(n,p)^{48}Sc$, $^{48}Ti(n,np)^{47}Ti$

$^{48}Ti(n,p)$ is considered a secondary reaction in the ILRR[1] program. It has the smallest cross section of the titanium isotopes construed as important in the program, but the highest abundance (∿ 74%).

The data in Region I are sparse, consisting of a few points measured by Smith,[8] Lukic,[3] and Ghoral.[2] See ^{46}Ti (np) above. All the available data sets in this Region were used as input.

As in the above reports Region II has no data but measurements to 10 MeV are underway by D.L. Smith of ANL.

In Region III Gabbard[23] measured the relative cross section as a function of energy on the U of Kentucky Electrostatic Accelerator, and then normalized to his own absolute measurements at 12.98, 13.75 and 16.60 MeV. Vonach[24] measured the relative cross section as a function of energy and normalized to $^{27}Al(n,\alpha)$ ^{24}Na = 111.5 mb at 14.7 MeV. Bormann's[12] data was available but not the details of the experiments. The data of Bormann, Vonach, Pai and Gabbard were used as input to SPLINE along with those of Smith, Ghorai and Lukic. The resulting curve was not renormalized since the 14.8 MeV value was approximately the same as that derived from a weighted average of the 14 MeV experiments. (See Table II). i.e. 66 mb.

The $^{48}Ti(n,np)^{47}Sc$, as in the case of ^{47}Ti described above, was determined by connecting the values indicated by Pai.[13]

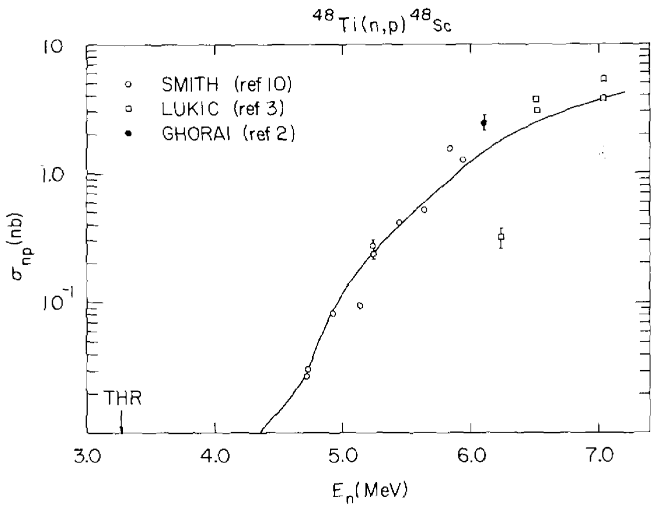


Figure 5

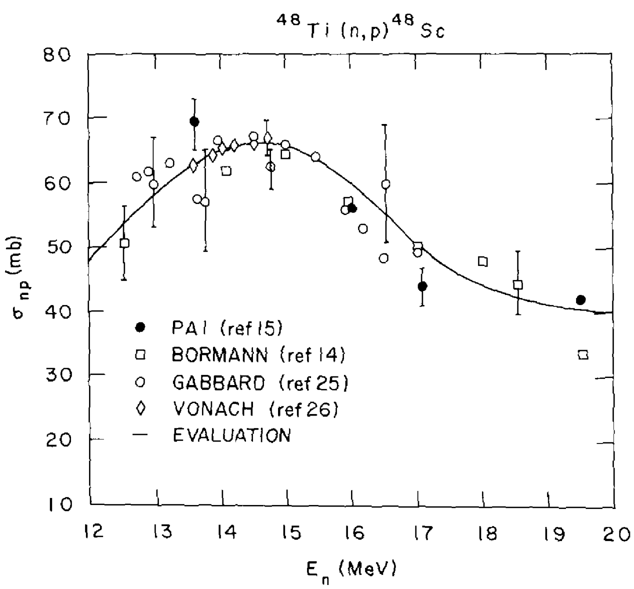


Figure 6

Table I

E(MeV)	σ(mb)	Reference
14.0	203 ± 21	D.L. Allen, Nuc. Phy. 24, 274 (1961).
14.0	240 ± 40	Bayhurst and Prestwood, in Fast Neutron Physics, Part II, Interscience Publ., N.Y. London (1963). Chapter V by Ribe.
14.5	268 ± 30	W.G. Cross and H.L. Pai, Private Comm. to M.D. Goldberg (1963).
14.7	324 ± 30	D.R. Koehler and W.L. Alford, J. Nucl. En. 18 A/B, 81 (1964).
14.8	230 ± 50	V.N. Levovskii et al., Yad Fiz 10, 44 (1969). Trans. in Sov. J. Nucl. Phys. 10, 25 (1969).
14.8	∿ 520	A. Poularikas and R.W. Fink, Phys. Rev. 115, 989 (1959).

Table II

14.0	61 ± 10	Bayhurst & Prestwood, Fast Neutron Physics, Part II Interscience Publ., N.Y. London (1963) Chapter V by Ribe.
14.5	55 ± 11	Hillman, Nuc. Phys. 37, 78 (1962).
14.5	93 ± 33	Paul & Clark, Can. J. Phys. 31, 267 (1953).
14.7	55	Koehler et al., J. Nuc. Energy 18, 81 (1964).
14.7	80 ± 4	Crumpton, J. Inorganic & Nuc. Chem. 31, 3727 (1966).
14.8	70 ± 6	Prasad et al., Nuova Cim. 3A, 467 (1971).
14.8	58 ± 8	Poularikis et al., P.R. 115, 989 (1959).
14.8	63 ± 6	Levkovskii et.al., Yad Fiz 10, 44 (1969).

References

1. Inter Laboratory LMFBR Reaction Rate Program (ILRR). McElroy - Private Comm. to M.K. Drake, Dec. 17, 1971.
2. Ghorai et al., J. Nuc. Energy 25, 319 (1971).
3. Lukic et al., Nuc. Sci. and Eng. 43, 233 (1971).
4. Grundl, Nuc. Sci. and Eng. 30, 39 (1967).
5. Santry et al., Can. J. Physics 42, 1030 (1964).
6. Butler et al., Can. J. Physics 41, 372 (1963).
7. Goldberg et al., Neutron Cross Sections, BNL 325, 2nd Ed. Vol. II (1966).
8. Smith et al., T.A.N.S. 16, 312 (1973) & Private Comm. 8/73.
9. Slavic et al., Private Comm., August 15, 1972.
10. Fabry, Bldg. 465, May 1972.
11. Liskien et al., Nuc. Physics 63, 393 (1965).
12. Bormann et al., EANDC (E) 57"U" (1965).
13. Pai, Can. J. Physics 44, 2337 (1966).
14. SPLINE, Private Comm., D.E. Cullen, March 1971.
15. Ahlberg et al., The Theory of Solines and Their Application, Acedemic Press (1967).
16. Armitage et al., Private Comm. to M.D. Goldberg (1967).
17. Gonzales et al., Phys. Rev. 126, 27 (1962).
18. Cross et al., Private Comm. to M.D. Goldberg (1963).
19. Allan, Nuc. Phys. 24, 274 (1961).
20. Hillman, Nuc. Phys. 37, 78 (1962).
21. Levkovskii et al., Yad. Fiz. 10, 44 (1969). (Trans. in Sov. J. Nuc. Phys. 10, 25 (1969).
22. Poularikis et al., Phys. Rev. 115, 989 (1959).
23. Gabbard et al., Phys. Rev. 128, 1276 (1962).
24. Vonach et al., Nuc. Tech. Conf. 2, E31 (1968).

TITANIUM-46 (N,P) NEUTRON CROSS SECTION ENDF/B MATERIAL NO. 6421

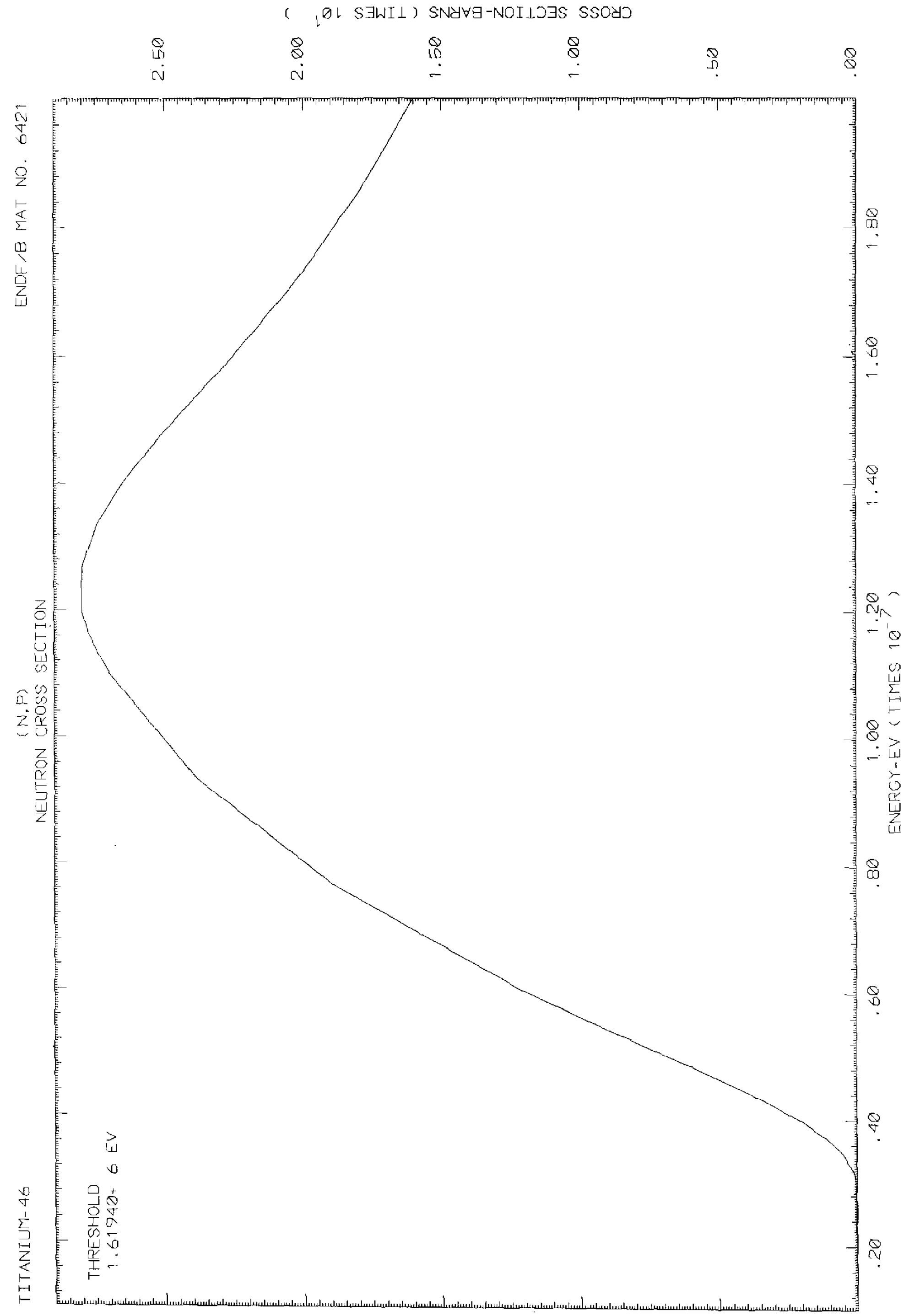
REACTION Q VALUE -1,5849E+06 EV

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION
1 TO 31	Y LINEAR IN X

NEUTRON CROSS SECTIONS

INDEX,	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	1,6194E+06	0,0000E+00	1,6300E+06	3,6400E-12	2,7502E+06	2,0000E-04	2,9000E+06	2,7100E-04	3,0000E+06	4,3668E-04
6	3,1000E+06	7,6225E-04	3,2000E+06	1.3900E-03	3,4600E+06	4,9904E-03	3,7200E+06	1,1294E-02	3,9800E+06	2,0000E-02
11	4,3200E+06	3.4411E-02	4,6600E+06	5,1162E-02	5,0000E+06	6,9000E-02	5,3333E+06	8,6490E-02	5,6667E+06	1,0357E-01
16	6,0000E+06	1.2000E-01	7,6667E+06	1,8922E-01	9,3333E+06	2,3838E-01	1,1000E+07	2,7000E-01	1,1333E+07	2,7438E-01
21	1,1667E+07	2,7783E-01	1,2000E+07	2,8000E-01	1,2667E+07	2,7982E-01	1,3333E+07	2,7442E-01	1,4000E+07	2,6500E-01
26	1,4667E+07	2,5279E-01	1,5333E+07	2,3904E-01	1,6000E+07	2,2500E-01	1,7333E+07	1.9943E-01	1,8667E+07	1,7777E-01
31	2,0000E+07	1,6000E-01								


TITANIUM-46
(N,P)
NEUTRON CROSS SECTION
ENDF/B MAT NO. 6421
THRESHOLD
1.61940+ 6 EV
ENERGY-EV (TIMES 10^7)
CROSS SECTION-BARNS (TIMES 10)
.20
.40
.60
.80
1.00
1.20
1.40
1.60
1.80
.00
.50
1.00
1.50
2.00
2.50

TITANIUM-47 (N,N') P NEUTRON CROSS SECTION ENDF/B MATERIAL NO. 6422

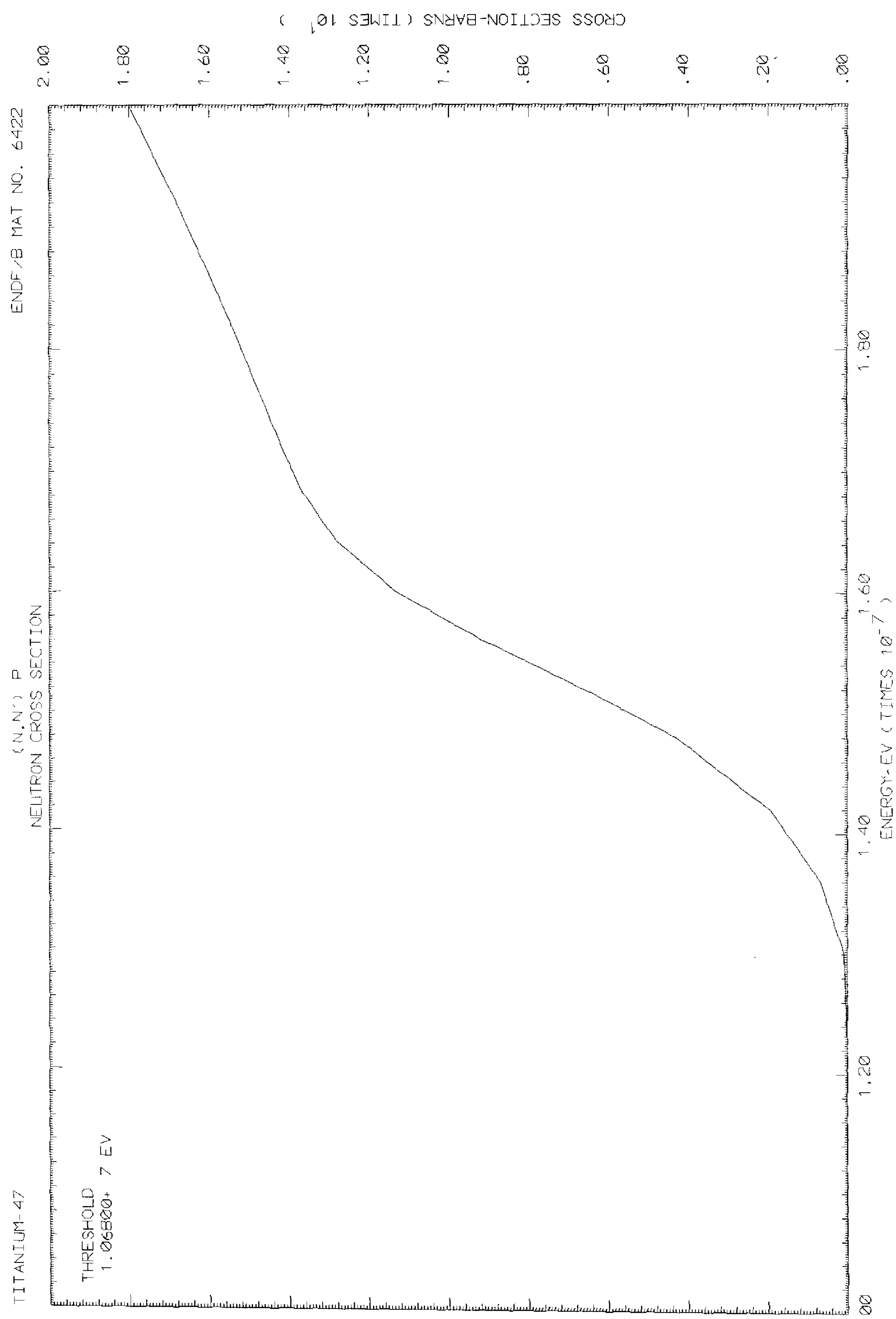
REACTION Q VALUE -1.0460E+07 EV

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION
1 TO 16	Y LINEAR IN X

NEUTRON CROSS SECTIONS

INDEX,	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	1.0680E+07	0.0000E+00	1.1453E+07	1.1500E-07	1.2227E+07	2.8500E-05	1.3000E+07	8.0000E-04	1.3600E+07	6.7245E-03
6	1.4200E+07	1.9265E-02	1.4800E+07	4.3000E-02	1.5200E+07	6.6217E-02	1.5600E+07	9.1274E-02	1.6000E+07	1.1300E-01
11	1.6433E+07	1.2844E-01	1.6867E+07	1.3731E-01	1.7300E+07	1.4300E-01	1.8200E+07	1.5436E-01	1.9100E+07	1.6669E-01
16	2.0000E+07	1.8000E-01								


TITANIUM-47
(N,N') P
NEUTRON CROSS SECTION
ENDF/B MAT NO. 6422
THRESHOLD
1.06800+ 7 EV
CROSS SECTION-BARNS (TIMES 10¹)
ENERGY-EV (TIMES 10⁷)
.00
.20
.40
.60
.80
1.00
1.20
1.40
1.60
1.80
2.00
1.00
1.20
1.40
1.60
1.80

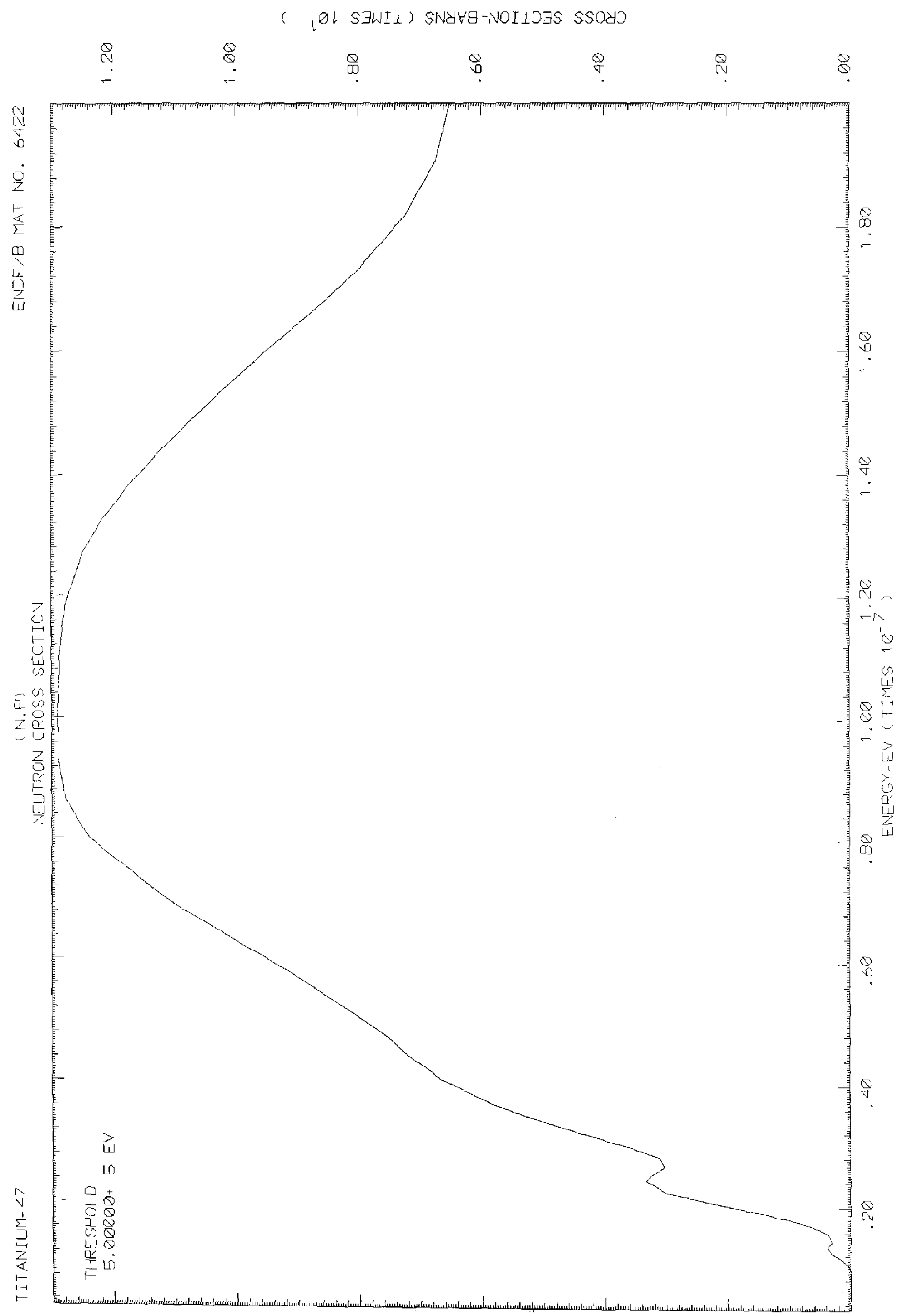
TITANIUM-47 — (N,P) NEUTRON CROSS SECTION — ENDF/B MATERIAL NO. 6422

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION
1 TO 52	Y LINEAR IN X

NEUTRON CROSS SECTIONS

INDEX,	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	5,0000E+05	0,0000E+00	6,3800E+05	1,0000E-09	7,7600E+05	1,3000E-06	9,1400E+05	2,4800E-05	9,8600E+05	1,3803E-04
6	1,0580E+06	4,7077E-04	1,1300E+06	1,2200E-03	1,1900E+06	2,2117E-03	1,2500E+06	3,1862E-03	1,3100E+06	3,7000E-03
11	1,3500E+06	3,6243E-03	1,3900E+06	3,3550E-03	1,4300E+06	3,1000E-03	1,5600E+06	3,6606E-03	1,6900E+06	6,3632E-03
16	1,8200E+06	1,1000E-02	2,0200E+06	2,0764E-02	2,2200E+06	2,9851E-02	2,4200E+06	3,3500E-02	2,4967E+06	3,7654E-02
21	2,5733E+06	3,1243E-02	2,6500E+06	3,0200E-02	2,7833E+06	3,0993E-02	2,9167E+06	3,4376E-02	3,0500E+06	3,9000E-02
26	3,2533E+06	4,6135E-02	3,4567E+06	5,2706E-02	3,6600E+06	5,8400E-02	4,0500E+06	6,6392E-02	4,4400E+06	7,1820E-02
31	4,8300E+06	7,6500E-02	5,8867E+06	9,2704E-02	6,9433E+06	1,1059E-01	8,0000E+06	1,2400E-01	8,6667E+06	1,2789E-01
36	9,3333E+06	1,2905E-01	1,0000E+07	1,2900E-01	1,0900E+07	1,2885E-01	1,1800E+07	1,2795E-01	1,2700E+07	1,2500E-01
41	1,3233E+07	1,2184E-01	1,3767E+07	1,1776E-01	1,4300E+07	1,1300E-01	1,4867E+07	1,0745E-01	1,5433E+07	1,0144E-01
46	1,6000E+07	9,5000E-02	1,6433E+07	8,9842E-02	1,6867E+07	8,4742E-02	1,7300E+07	8,0000E-02	1,8200E+07	7,2155E-02
51	1,9100E+07	6,7155E-02	2,0000E+07	6,5000E-02						



TITANIUM-47
THRESHOLD
5.00000+ 5 EV
(N,P)
NEUTRON CROSS SECTION
ENDF/B MAT NO. 6422
ENERGY-EV (TIMES 10^7)
CROSS SECTION-BARNS (TIMES 10^1)
.20 .40 .60 .80 1.00 1.20 1.40 1.60 1.80
.00 .20 .40 .60 .80 1.00 1.20

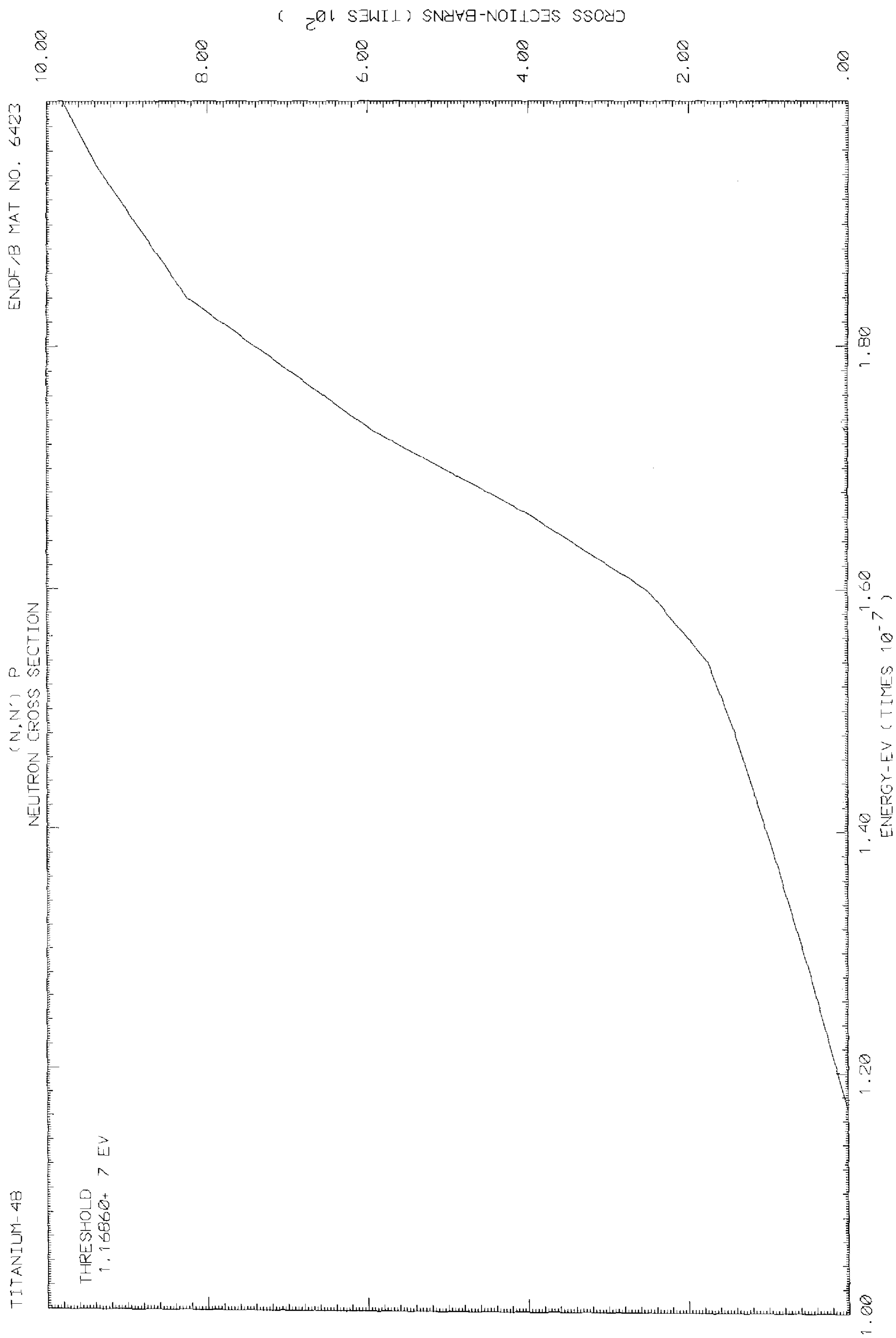
REACTION Q VALUE -1.1446E+06 EV

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION
1 TO 12	Y LINEAR IN X

NEUTRON CROSS SECTIONS

INDEX,	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	1,1689E+07	0,0000E+00	1,2683E+07	4,0848E-03	1,3680E+07	8,6000E-03	1.4240E+07	1.1302E-02	1.4800E+07	1.4000E-02
6	1,5400E+07	1.7464E-02	1.6000E+07	2,5000E-02	1,6650E+07	4,0612E-02	1,7300E+07	5.9000E-02	1,8400E+07	8,2515E-02
11	1,9500E+07	9.4000E-02	2,0000E+07	9,8000E-02						


TITANIUM-48
(N,N') P
NEUTRON CROSS SECTION
ENDF/B MAT NO. 6423
THRESHOLD
1.16860+ 7 EV
CROSS SECTION-BARNS (TIMES 10^2)
ENERGY-EV (TIMES 10^-7)
10.00
8.00
6.00
4.00
2.00
.00
1.00
1.20
1.40
1.60
1.80

TITANIUM-48 (N,P) NEUTRON CROSS SECTION ENDF/B MATERIAL NO. 6423

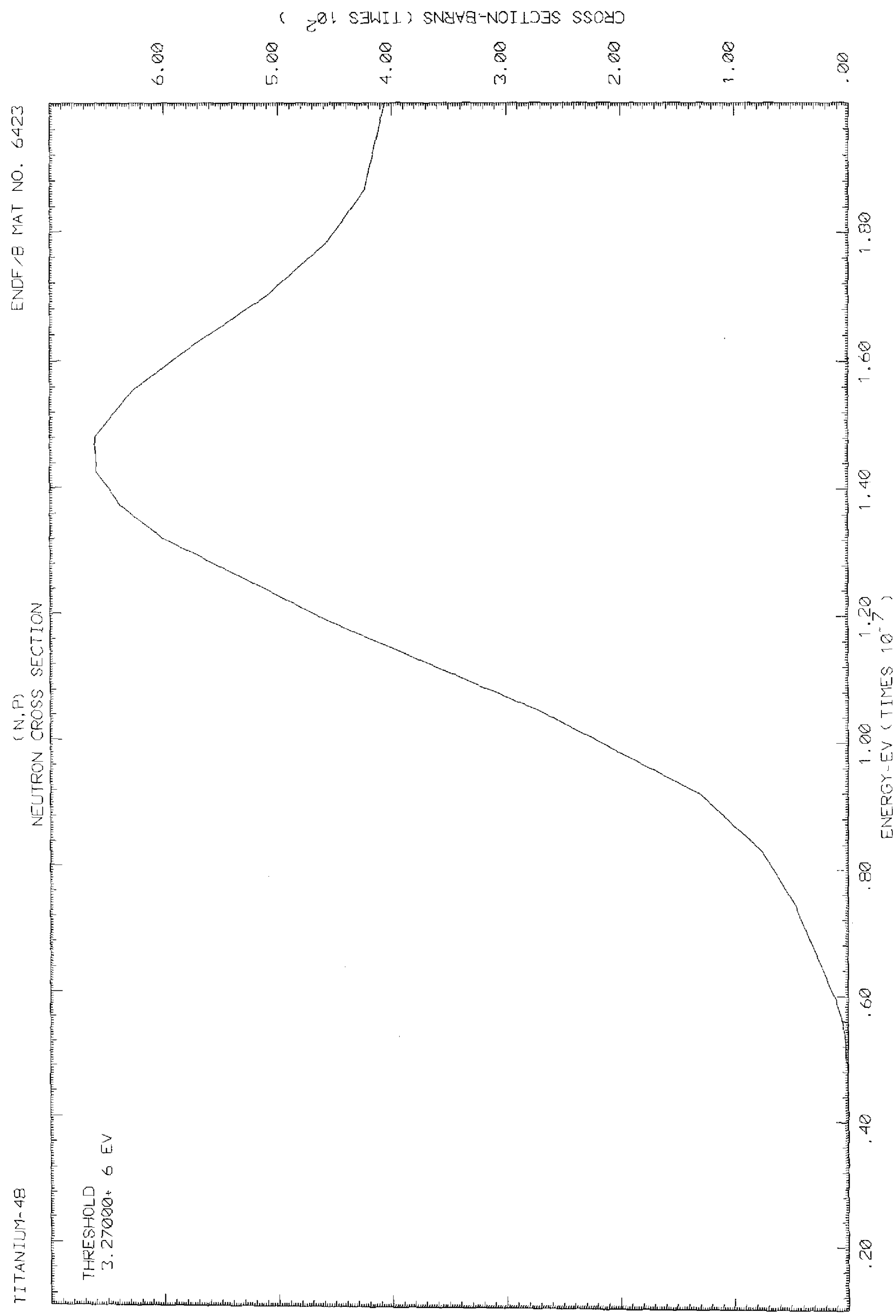
REACTION Q VALUE -3,2080E+06 EV

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION
1 TO 28	Y LINEAR IN X

NEUTRON CROSS SECTIONS

INDEX,	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	3,2700E+06	0,0000E+00	3.7600E+06	3.1000E-06	4,2500E+06	8,0000E-06	4.7400E+06	3.1000E-05	4,9033E+06	8.8889E-05
6	5,0667E+06	1.5833E-04	5,2300E+06	2.4000E-04	5,3667E+06	3,2107E-04	5,5033E+06	4.2860E-04	5,6400E+06	5.8000E-04
11	5,9367E+06	1,0930E-03	6,2333E+06	1.7735E-03	6,5300E+06	2,5000E-03	7,4200E+06	4.5537E-03	8,3100E+06	7,5227E-03
16	9,2000E+06	1,3000E-02	1,0533E+07	2,7481E-02	1,1867E+07	4,5152E-02	1,3200E+07	6.0000E-02	1,3733E+07	6,3815E-02
21	1,4267E+07	6,5915E-02	1,4800E+07	6,6000E-02	1,5533E+07	6,2734E-02	1,6267E+07	5,7072E-02	1,7000E+07	5,1000E-02
26	1,7833E+07	4,5634E-02	1,8667E+07	4,2301E-02	2,0000E+07	4,0600E-02				


TITANIUM-48
THRESHOLD
3.27000+ 6 EV
(N,P)
NEUTRON CROSS SECTION
ENDF/B MAT NO. 6423
CROSS SECTION-BARNS (TIMES 10^-2)
.00
1.00
2.00
3.00
4.00
5.00
6.00
ENERGY-EV (TIMES 10^7)
.20
.40
.60
.80
1.00
1.20
1.40
1.60
1.80

Evaluation of the $^{55}Mn(n,2n)^{54}Mn$ Cross Section for ENDF/B-IV

B.A. Magurno and H. Takahashi*
NNCSC
Brookhaven National Laboratory

The $^{55}Mn(n,2n)^{54}Mn$ cross section was one of the reactions to be supplied by the Cross Section Evaluation Working Group (CSEWG) for the Interlaboratory LMFBR Reaction Rate Program (ILRR). This reaction was later incorporated into a complete isotopic evaluation for ENDF/B-IV by H. Takahashi. The description of the evaluation (below) was extracted from the final report.(1)

The (n,2n) activation cross section of Mn^{55} in the neutron range from 12.6 to 19.6 MeV has been measured by Menlove et al.(2) and A. Paulsen, and H. Liskien.(3) The other data for the cross sections were obtained either at one energy around 14 MeV or measured over the fission neutron spectrum.(4)

Paulsen and Liskien's data are about 15% higher than the Menlove data and also show small fluctuations. The Paulsen and Liskien experiment was performed by using a proton recoil telescope to measure the absolute flux, and the Menlove data are obtained from the ratio measurements to the U^{235} fission cross section.

These cross sections were evaluated by comparing these with the results calculated by using the nuclear model codes GRØGI-III(5) and THRESH.(6)

*Now at Tokyo Institute of Technology.

†Submitted to the normalization and standards subcommittee Oct. 1973. This evaluation has since been incorporated into the ENDF/B-IV General Purpose File.

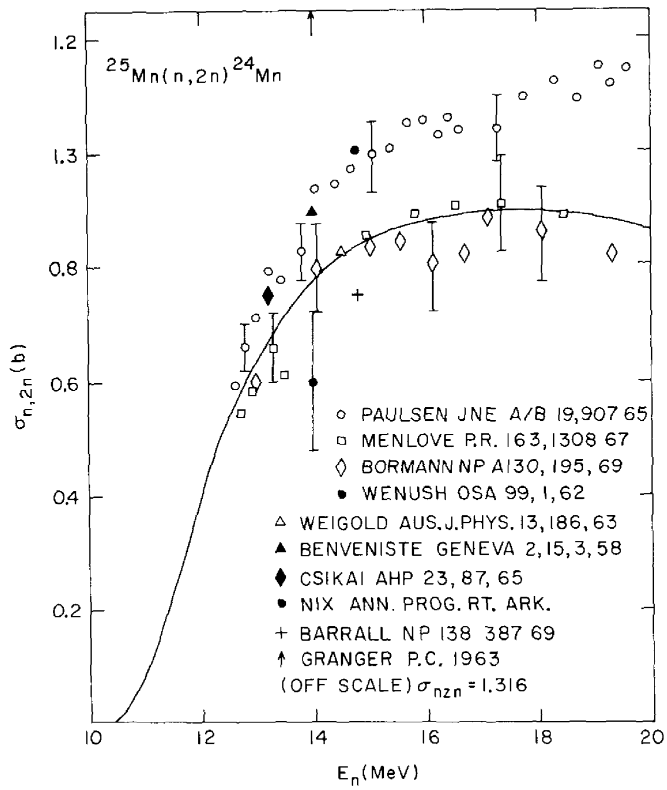


Figure 1

There are no experimental data near the threshold energy, (Q= -10.225 MeV) and GRØGI-III code cannot treat the discrete excited level, so that the cross sections near the threshold were carefully evaluated by using the transmission coefficients obtained from optical model calculations.

References

1. Takahashi, "Evaluation of the Neutron and Gamma Ray Production Cross Sections for ^{55}Mn". BNL 19454 (ENDF-208) Nov. 1974.
2. Menlove et al., Phys. Rev. 163, 1308 (1967).
3. Paulsen and Liskien, J. Nuc. Energy A/B 19, 907 (1965).
4. Bormann et al., Nuc. Phys. A130, 195 (1969).
5. Takahashi, "Grogi-III" Modified Version of Grogi-II by J. Gilat BNL 50246 June 1970.
6. Pearlstein, "THRESH" J. Nuc. Energy 27, 81 (1973).

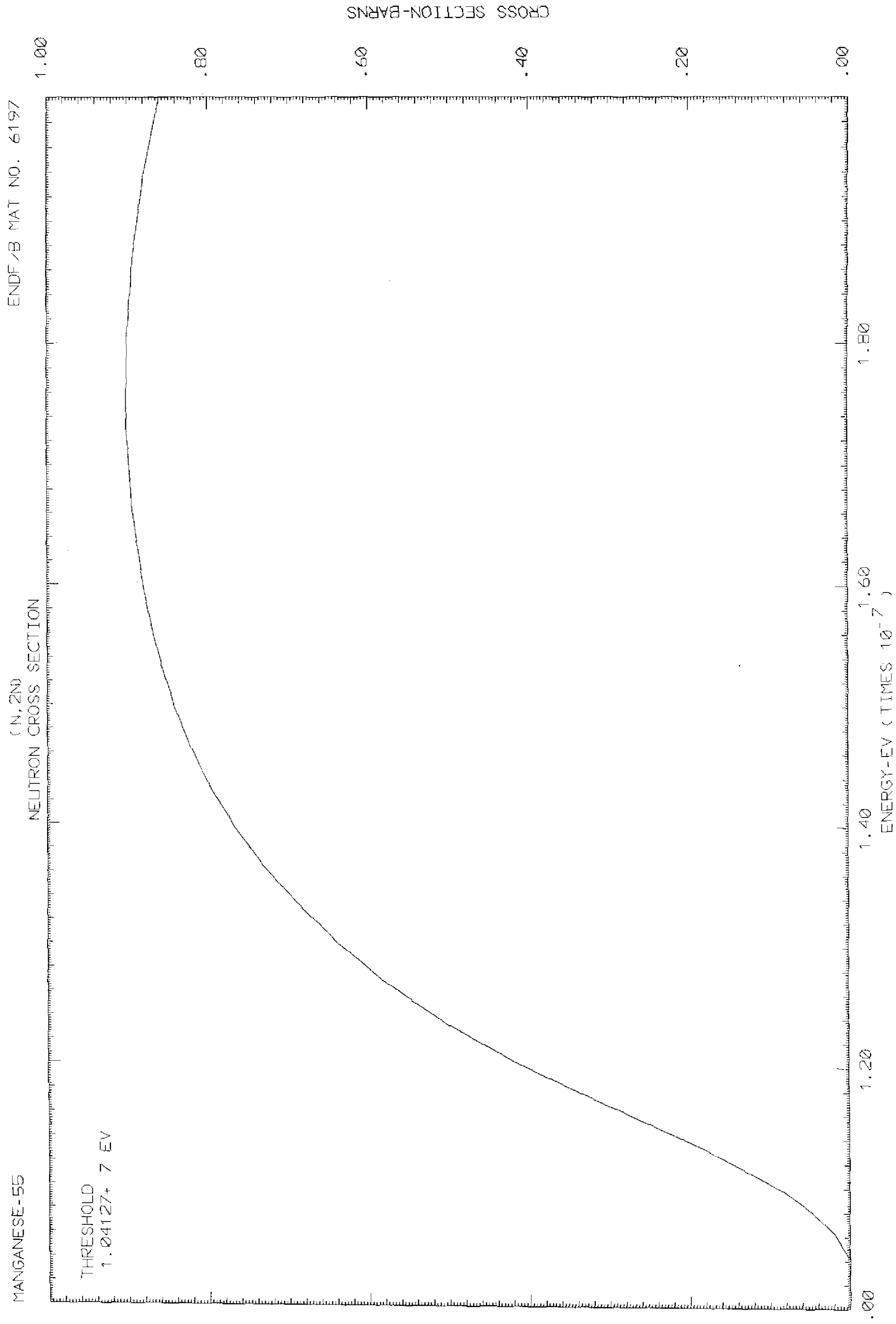
REACTION Q VALUE -1.0224E+07 EV

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION
1 TO 26	Y LINEAR IN X

NEUTRON CROSS SECTIONS

INDEX,	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	1.0413E+07	0.0000E+00	1.0413E+07	2.3283E-10	1.0607E+07	1.7294E-02	1.0803E+07	4.6961E-02	1.1000E+07	8.9000E-02
6	1.1333E+07	1.8532E-01	1.1667E+07	2.9803E-01	1.2000E+07	4.0800E-01	1.2333E+07	5.0000E-01	1.2667E+07	5.7452E-01
11	1.3000E+07	6.3600E-01	1.3333E+07	6.8821E-01	1.3667E+07	7.3236E-01	1.4000E+07	7.6900E-01	1.4333E+07	7.9879E-01
16	1.4667E+07	8.2275E-01	1.5000E+07	8.4200E-01	1.5333E+07	8.5755E-01	1.5667E+07	8.7003E-01	1.6000E+07	8.8000E-01
21	1.6667E+07	8.9391E-01	1.7333E+07	9.0041E-01	1.8000E+07	9.0000E-01	1.8667E+07	8.9309E-01	1.9333E+07	8.7975E-01
26	2.0000E+07	8.6000E-01								


MANGANESE-55
(N,2N)
NEUTRON CROSS SECTION
ENDF/B MAT NO. 6197
THRESHOLD
1.04127+ 7 EV
CROSS SECTION-BARNS
1.00
.80
.60
.40
.20
.00
1.00
1.20
1.40
1.60
1.80
ENERGY-EV (TIMES 10^-7)

Evaluation of the $^{54}Fe(n,p)^{54}Mn$ Reaction

For ENDF/B-III Dosimetry File

R.E. Schenter - August 1973

Hanford Engineering and Development Laboratory

The literature reviewed in this evaluation includes all references in CINDA 72 and its supplements plus papers describing recent measurements by Smith and Meadows and Paulsen and Widera. Fig. 1-5 show the evaluation made (solid curve) together with available experimental data and some previous evaluations. Below 2.5 MeV Smith and Meadows and Paulsen and Widera values were used directly (Fig. 1-2). Between 2.5 and 6.0 MeV Smith and Meadows results were directly used (Fig. 3). Smith and Meadows results were normalized relative to the ENDF/B-III ^{235}U fission cross section. Above 6.0 MeV a smooth "eye-guide" curve was constructed (Fig. 4-5) which fell between previous evaluations (6-13 MeV) and numerous experimental results (13-17 MeV).

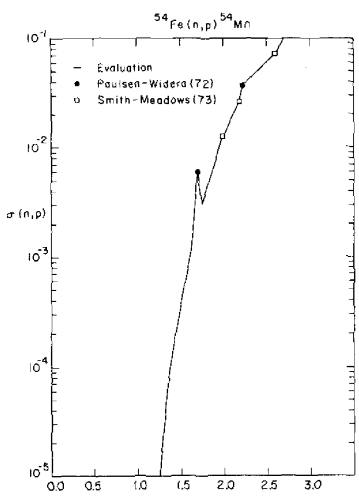


Figure 1

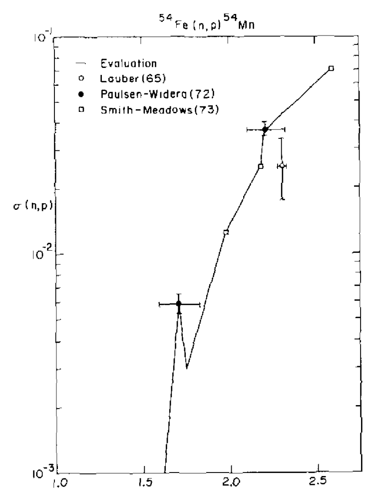


Figure 2

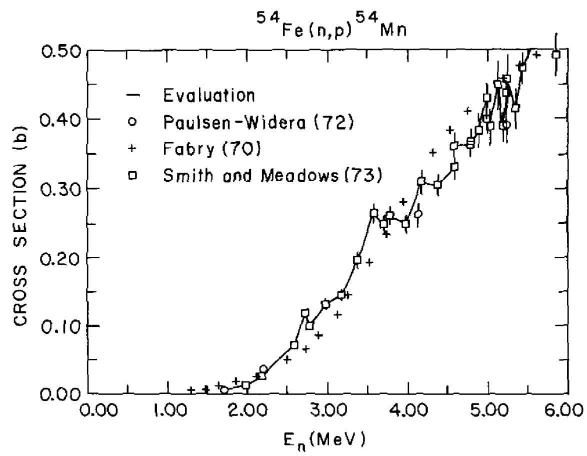


Figure 3

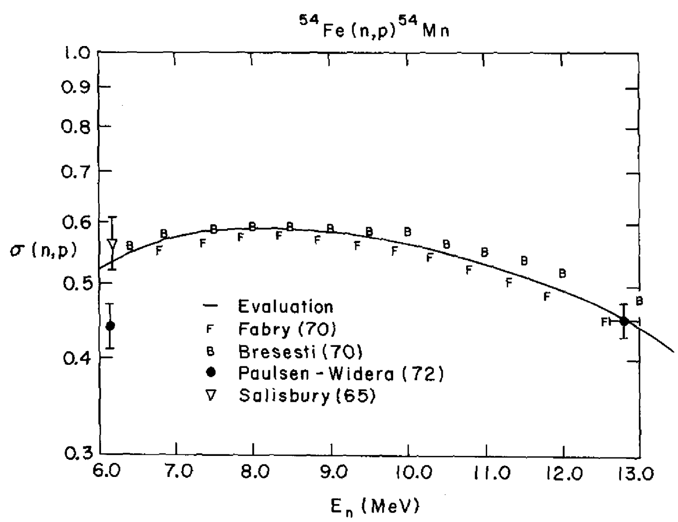
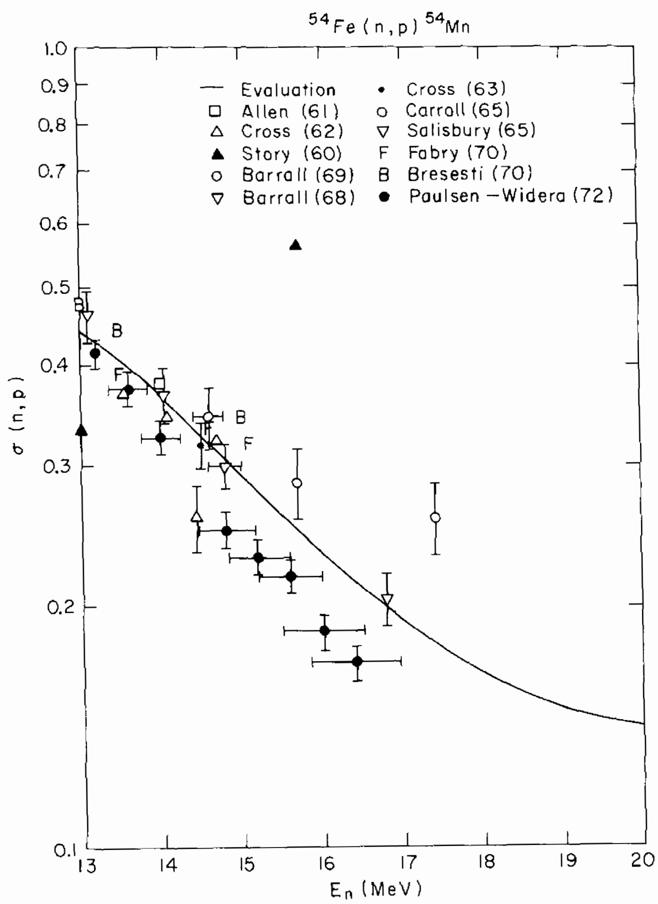


Figure 4



$^{54}Fe(n,p)^{54}Mn$
Evaluation
Allen (61)
Cross (62)
Story (60)
Barrall (69)
Barrall (68)
Cross (63)
Carroll (65)
Salisbury (65)
F Fabry (70)
B Bresesti (70)
Paulsen – Widera (72)
σ (n, p)
E$_n$ (MeV)

Figure 5

References

1. Smith and Meadows Trans. Am. Nucl. Soc. 16, 1 (1973).
2. Paulsen and Widera, EANDC (E) 150U, 1972.
3. Fabry et al., EANDC (E) 127U, 1970.
4. Simons et al., BNWL-1312, 1970.
5. Bresesti, Nuc. Sci. and Eng. 40, 331 (1970).
6. Barrall et al., Nuc. Phys. A138, 387 (1969).
7. Carroll et al., Nuc. Sci. and Eng. 22, 411 (1965).
8. Salisbury et al., Phys. Rev. B140, 305 (1965).
9. Lauber et al., Nuc. Phys. 73, 234 (1965).
10. Cross et al., EANDC (CAN) 16, (1963).
11. Cross et al., AECL 1542, (1962).
12. Storey et al., Proc. Phys. Soc. 75, 526 (1960).

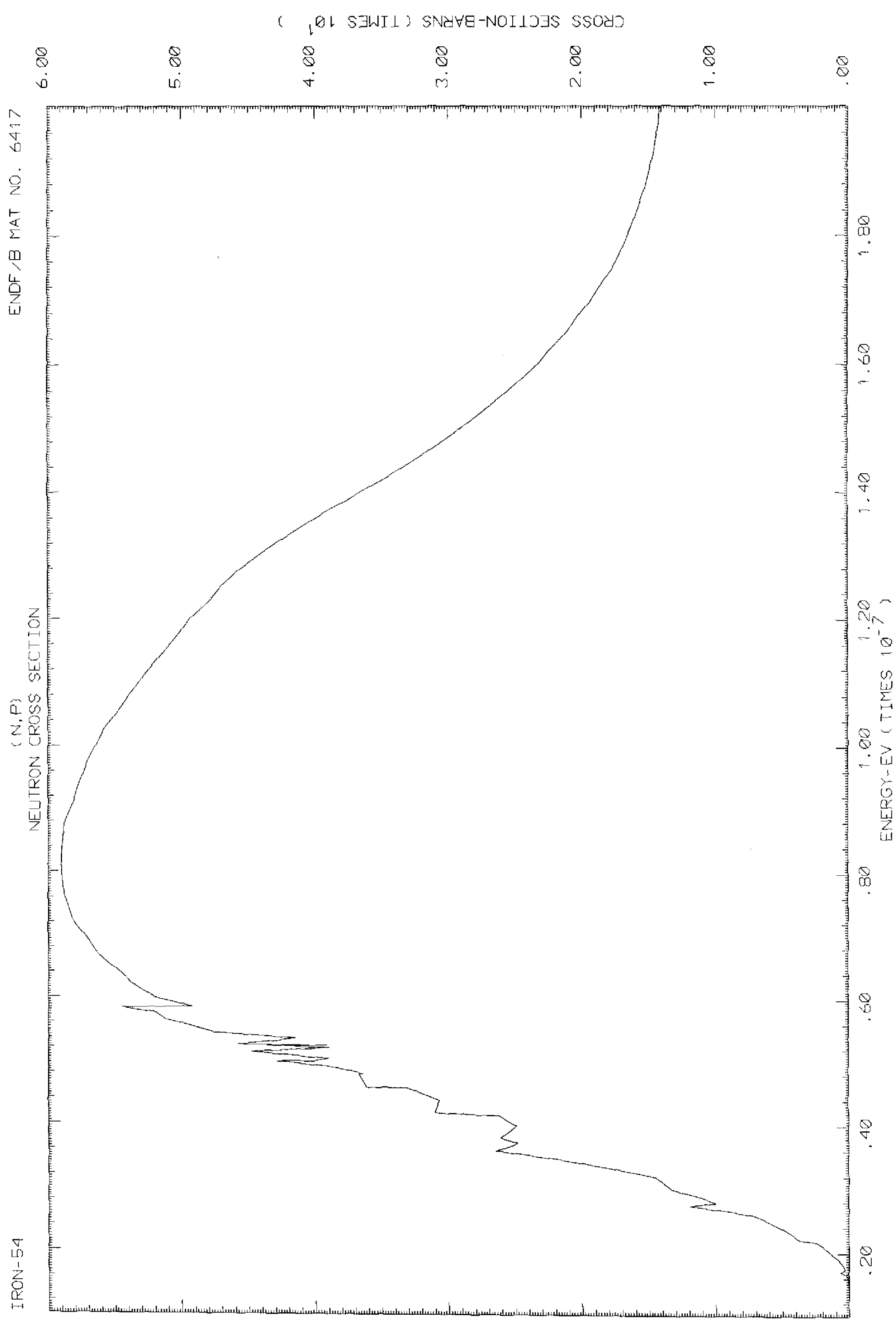
REACTION Q VALUE 8.8000E+05 EV

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION
1 TO 101	LN Y LINEAR IN X

NEUTRON CROSS SECTIONS

INDEX.	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	1.2500E+06	1.0000E-05	1.3750E+06	9.5000E-05	1.5000E+06	3.5000E-04	1.6250E+06	1.1600E-03	1.7100E+06	5.9000E-03
6	1.7500E+06	3.0000E-03	1.9000E+06	7.8500E-03	1.9790E+06	1.2700E-02	2.1810E+06	2.6200E-02	2.2100E+06	3.7200E-02
11	2.5890E+06	7.2100E-02	2.7270E+06	1.1900E-01	2.7820E+06	9.9600E-02	2.7920E+06	1.0000E-01	2.9850E+06	1.3200E-01
16	3.1870E+06	1.4500E-01	3.3850E+06	1.9700E-01	3.5870E+06	2.6500E-01	3.7160E+06	2.4800E-01	3.7880E+06	2.6100E-01
21	3.9900E+06	2.4900E-01	4.1400E+06	2.6200E-01	4.1830E+06	3.1000E-01	4.3850E+06	3.0600E-01	4.5870E+06	3.3100E-01
26	4.5870E+06	3.6100E-01	4.7950E+06	3.6700E-01	4.7960E+06	3.6400E-01	4.8950E+06	3.8300E-01	4.9960E+06	4.2900E-01
31	4.9960E+06	4.0100E-01	5.0370E+06	3.8900E-01	5.1370E+06	4.4800E-01	5.1990E+06	3.8900E-01	5.2380E+06	4.3600E-01
36	5.2400E+06	3.9100E-01	5.2550E+06	4.5800E-01	5.3550E+06	4.1500E-01	5.4380E+06	4.7400E-01	5.6380E+06	5.1100E-01
41	5.7550E+06	5.1900E-01	5.8400E+06	5.4500E-01	5.8560E+06	4.9200E-01	5.9380E+06	5.0800E-01	6.0000E+06	5.2000E-01
46	6.2500E+06	5.3800E-01	6.5000E+06	5.5200E-01	6.7500E+06	5.6500E-01	7.0000E+06	5.7300E-01	7.2500E+06	5.8200E-01
51	7.5000E+06	5.8600E-01	7.7500E+06	5.8900E-01	8.0000E+06	5.9000E-01	8.2500E+06	5.9000E-01	8.5000E+06	5.8900E-01
56	8.7500E+06	5.8800E-01	9.0000E+06	5.8300E-01	9.2500E+06	5.7900E-01	9.5000E+06	5.7500E-01	9.7500E+06	5.7000E-01
61	1.0000E+07	5.6400E-01	1.0250E+07	5.5800E-01	1.0500E+07	5.4900E-01	1.0750E+07	5.4000E-01	1.1000E+07	5.3200E-01
66	1.1250E+07	5.2200E-01	1.1500E+07	5.1200E-01	1.1750E+07	5.0200E-01	1.2000E+07	4.9300E-01	1.2250E+07	4.8000E-01
71	1.2500E+07	4.7000E-01	1.2750E+07	4.5800E-01	1.3000E+07	4.4200E-01	1.3250E+07	4.2500E-01	1.3500E+07	4.0600E-01
76	1.3750E+07	3.8700E-01	1.4000E+07	3.6500E-01	1.4250E+07	3.4500E-01	1.4500E+07	3.2500E-01	1.4750E+07	3.0700E-01
81	1.5000E+07	2.9000E-01	1.5250E+07	2.7500E-01	1.5500E+07	2.6000E-01	1.5750E+07	2.4600E-01	1.6000E+07	2.3200E-01
86	1.6250E+07	2.2200E-01	1.6500E+07	2.1000E-01	1.6750E+07	2.0200E-01	1.7000E+07	1.9200E-01	1.7250E+07	1.8400E-01
91	1.7500E+07	1.7600E-01	1.7750E+07	1.7000E-01	1.8000E+07	1.6500E-01	1.8250E+07	1.6000E-01	1.8500E+07	1.5600E-01
96	1.8750E+07	1.5200E-01	1.9000E+07	1.4900E-01	1.9250E+07	1.4600E-01	1.9500E+07	1.4400E-01	1.9750E+07	1.4200E-01
101	2.0000E+07	1.4100E-01								


IRON-54
(N,P)
NEUTRON CROSS SECTION
ENDF/B MAT NO. 6417
CROSS SECTION-BARNS (TIMES 10^1)
6.00
5.00
4.00
3.00
2.00
1.00
.00
ENERGY-EV (TIMES 10^7)
.20
.40
.60
.80
1.00
1.20
1.40
1.60
1.80

Evaluation of the $^{56}Fe(n,p)^{56}Mn$ Cross Sections for ENDF/B-III

N. D. Dudey and Robert Kennerley

Argonne National Laboratory

The literature examined in this review includes all references in CINDA 71 and its supplements plus some very recent measurements near the reaction threshold. All reference cross sections have been renormalized to ENDF/B-III cross sections and weighted least-squares fitting routines were used to systematize the evaluations.

Virtually all measurements on ^{56}Fe used the activation technique to determine ^{56}Mn in activated natural iron samples. As a result, the $^{57}Fe(n,np+d)$ and $^{58}Fe(n,t)$ cross section contributions to ^{56}Mn are included in the measurements. For dosimetry purposes, elemental iron is usually used, so the evaluated cross sections are appropriate for this application. It should be recognized however, that this evaluation is not strictly $^{56}Fe(n,p)$. Chittenden[1] has measured the $^{57}Fe(n,np)$ cross sections at 14.8 MeV to be 6.1 mb. From this result it can be concluded that below about 15 MeV contributions to the ^{56}Mn activity are negligible (<0.3%) but above 15 MeV they may be more significant.

The evaluation approach is largely based upon a subjective analysis of the experimental technique. From this analysis a weighting factor was assigned to each of the reported results. The next step was to relate all relative measurements to ENDF/B-III cross sections if a monitor reaction was used. Santry and Butler[2] measured relative to the $^{32}S(n,p)$ reaction. The measurement was renormalized to the evaluation of ^{32}S (submitted to the task force working group) which was essentially relative to the $^{238}U(n,f)$ reaction. Liskien and Paulsen[(3)] essentially measured relative to H(n,p) and no renormalization was necessary. Grundl[(4)] and Meadows[(5)] measured relative to $^{238}U(n,f)$ and both sets of data were renormalized to ENDF/B-III. Cuzzocrea[(6)] reports a number of measurements for ^{56}Fe and several other cross sections including $^{27}Al(n,\alpha)$ between 13.7 and 14.7 MeV. In general, all of their results were high; a flux calibration problem was assumed and their ^{56}Fe data was renormalized by relating their $^{27}Al(n,\alpha)$ results to the revised evaluation of ^{27}Al provided by P.G. Young. Hemingway[(8)] reported ^{56}Fe results by the associated alpha particle technique so no renormalization was necessary.

Fourteen individual measurements[(9-22)] are reported for the energy region 14-15 MeV. Bormann[(23)] has measured relative ^{56}Fe cross sections and normalized to a value of 112.5 at 14.1 MeV. Similarly, Terrell and Holm[(24)] normalized their relative data to a value of 110 mb at 14.3 MeV. All data between 13.5 and 15 MeV were fit, weighted according to an in house assessment, to obtain renormalization values for Bormann and Terrell-Holm. The renormalization values were 110.3 and 108.8, respectively.

Bresesti[(25)] and Fabry[(26)] both measured a number of spectrum averaged cross section ratios in a thermal neutron induced ^{235}U fission spectrum. Bresesti assumed a cross section shape for ^{56}Fe

based upon Liskien-Paulsen and Santry-Butler and determined the magnitude based upon integral ratios and an assumed fission spectrum. Fabry did essentially the same, except he allowed the shapes to vary in an ill-defined way to essentially measure ^{56}Fe relative to 6 other cross sections including $^{235}U(n,f)$. An adjustment to Fabry's ^{56}Fe data was made by renormalizing his reported $^{235}U(n,f)$ data to the ENDF/B-III evaluation.

Finally, all renormalized cross sections were weighted according to a subjective analysis and least squares fit to obtain the evaluated excitation function. Figures 1 and 2 show all the renormalized data together with the evaluated curve. The evaluated cross sections are tabulated in Table I using an energy grid such that a linear interpolation between points will result in a negligible error. In Fig. 3 a comparison is shown of this evaluation to those of Kanda and Nakasima(27) and the SAND-II evaluated library.(28) All three evaluations are very similar up to about 15 MeV where SAND-II begins to deviate significantly.

On the basis of this evaluation, it is felt that the shape of the excitation function is established with considerable confidence and the magnitude of the cross sections seems to be established to within about ±5%. For dosimetry applications to LMFBR-type neutron spectra, no further experimental work would seem necessary.

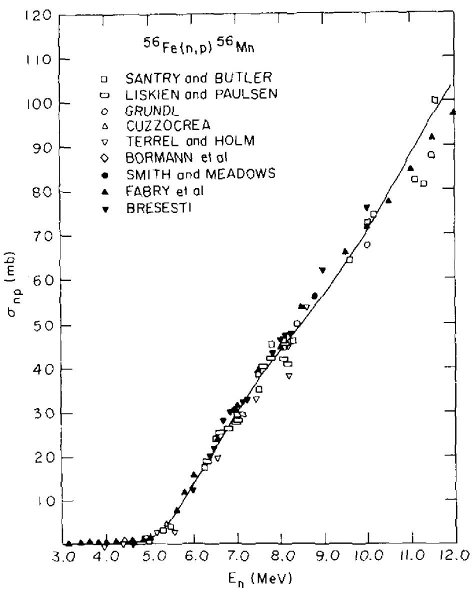


Figure 1

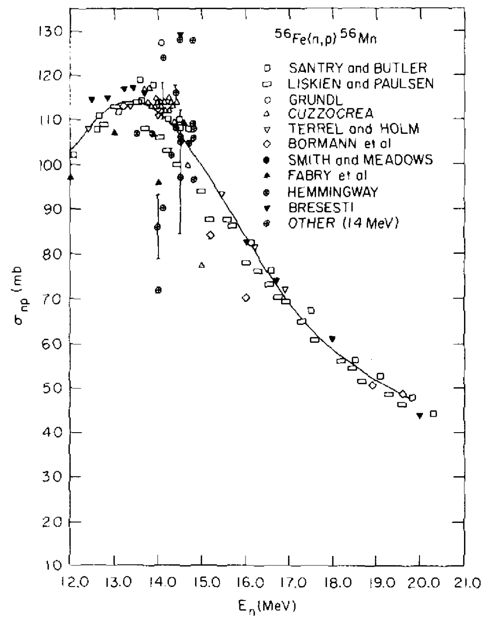


Figure 2

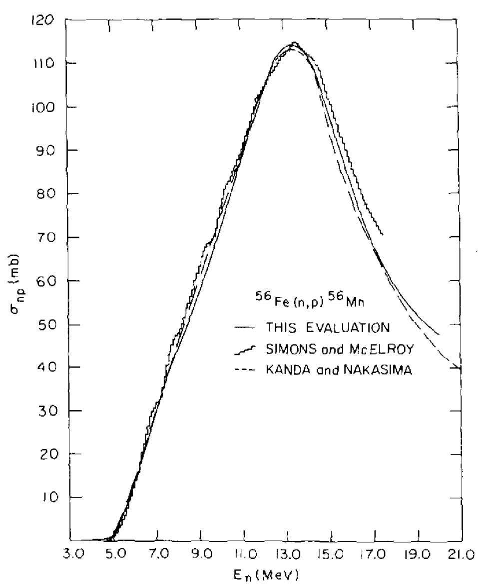


Figure 3

References

1. D.M. Chittenden, D.G. Gardner, and R.W. Fink, Physical Review 122, 860 (1961).
2. D.C. Santry and J.P. Butler, Can. J. Phys. 42, 1030 (1964).
3. H. Liskien and A. Paulsen, Jour. Nucl. Energy 19, 73 (1965). H. Liskien and A. Paulsen, NUK 8, 315 (1966).
4. J. Grundl, Nucl. Sci. and Eng. 40, 331 (1970).
5. J.W. Meadows and D.L. Smith, unpublished private communication (1972).
6. P. Cuzzocrea and E. Perillo, Nuovo Cimento 54, 53 (1968).
7. P.G. Young, private communication (1972).
8. J.D. Hemingway, R.H. James, E.B.M. Martin, and G.R. Martin; Proc. Roy. Soc. A292, 180 (1966).
9. D.L. Allan, Nuc. Phy. 24, 274 (1961).
10. G.W. McClure and D.W. Kent, Journ Frank. Inst. 260, 238 (1955).
11. H. Pollehn and H. Neuert, Zeit. Naturforsch. 16A, 227 (1961).
12. R. S. Storey, W. Jack, and A. Ward, Proc. Phys. Soc. (London) 75, 526 (1959).
13. Shinjirō Yasumi, Jour. Phys. Soc. Japan 12, 443 (1957).
14. S.G. Forbes, Phys. Rev. 88, 1309 (1952).
15. P. Strohal, P. Kulisic, Z. Kolar, and N. Cindro, Phys. Letters 10, 106 (1964).
16. F. Gabbard and B.D. Kern, Phys. Rev. 123, 1276 (1962).
17. W.G. Cross, R.L. Clark, K. Morin, G. Slinn, N.M. Ahmed, and K. Beg, Bull Am. Phy Soc 7, 335 (1962).

18. E. B. Paul and R.L. Clarke, Can Jour Phys. 31, 267 (1952).

19. G.C. Bonazzola, P. Broretto, E. Chiavassa, R. Spinoglio, and A. Pasquarelli, Nuc. Phys. 51, 337 (1964).

20. R.C. Barrall, M. Silbergeld, and D.G. Gardner, Nuc. Phys. A138, 387 (1969).

21. V. Levkovskii, G.E. Kovel'skaya, G.P. Vinitskaya, V.M. Stepanov, and V.V. Sokol'skii, Soviet Journal of Nuclear Physics 8, 4 (1970).

22. P. Hille, Oestem. Akad. Wiss. Mata. and Naturw. Sitzber. (Austria) 177, 463 (1969).

23. M. Bormann, S. Cierjacks, R. Lankau, and H. Neuert, Z. Physik 166, 477 (1962).

24. J. Terrell and D.M. Holm, Phys. Rev. 109, 2031 (1958).

25. A.M. Bresesti, M. Bresesti, A. Rota, R.A. Rydin, and L. Lesca, Nucl. Sci. and Eng. 40, 331 (1970).

26. A. Fabry, M. DeCoster, G. Minsart, J.C. Shepers, and P. Vandeplas, IAEA-CN-26/39, p. 533, Helskini (1970).

27. Y. Kanda and R. Nakasima, NBS Sp. Pub. 299, Vol. 1, p. 193, Washington, D.C. (1968).

28. R.L. Simons and W.N. McElroy, "Evaluated Reference Cross Section Library", BNWL-1312 (1970).

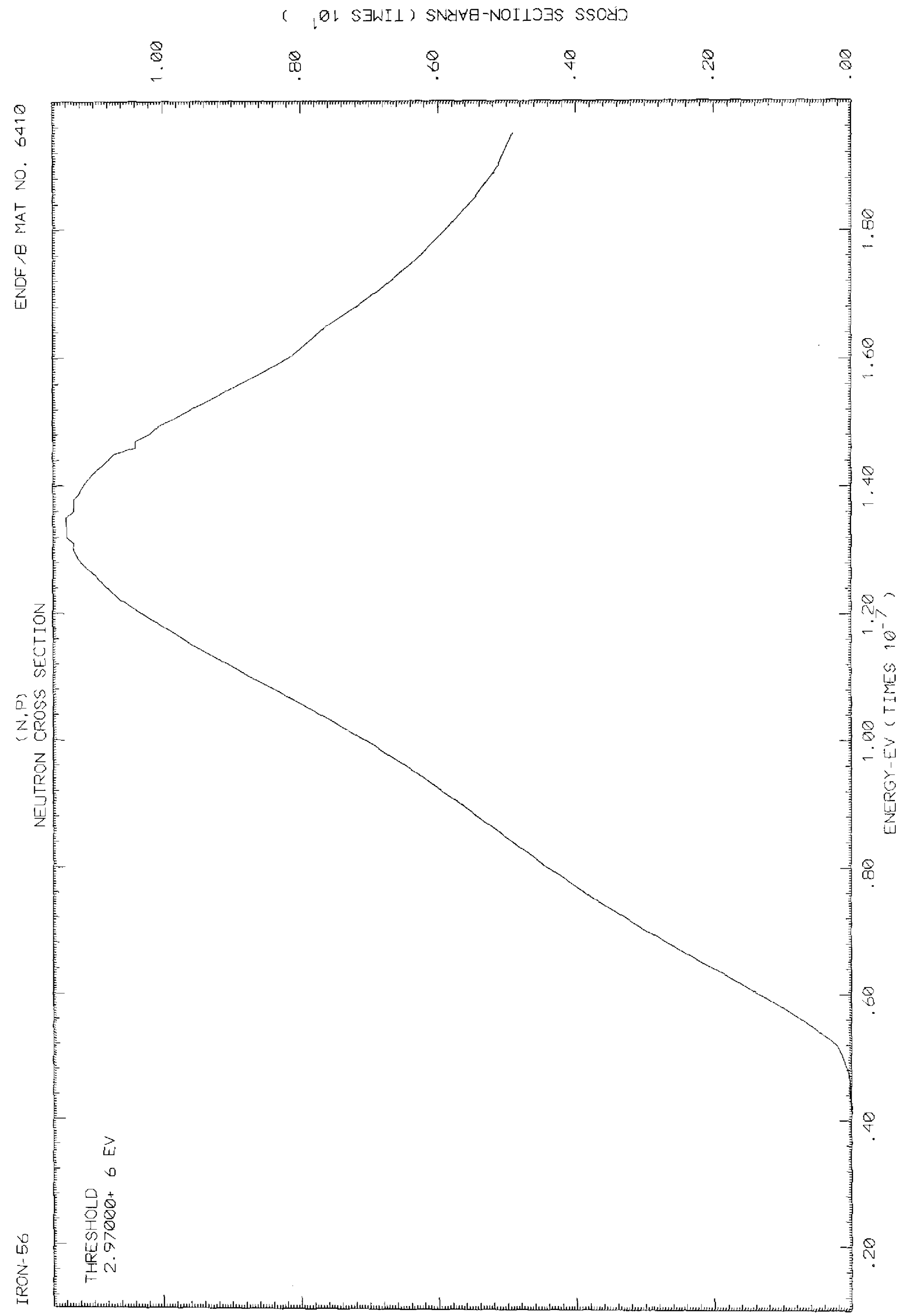
REACTION Q VALUE -2.9550E+06 EV

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION
1 TO 77	Y LINEAR IN X

NEUTRON CROSS SECTIONS

INDEX,	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	2.9700E+06	0.0000E+00	3.0000E+06	1.1000E-07	3.1000E+06	1.5000E-07	3.2000E+06	2.1000E-07	3.3000E+06	2.9500E-07
6	3.4000E+06	4.2000E-07	3.5000E+06	6.2000E-07	3.6000E+06	9.8000E-07	3.7000E+06	1.5000E-06	3.8000E+06	2.5000E-06
11	3.9000E+06	4.4000E-06	4.0000E+06	8.0000E-06	4.1000E+06	1.2000E-05	4.2000E+06	2.9000E-05	4.3000E+06	5.6000E-05
16	4.4000E+06	9.3000E-05	4.5000E+06	1.5000E-04	4.6000E+06	2.3800E-04	4.7000E+06	3.7500E-04	4.8000E+06	5.5500E-04
21	4.9000E+06	8.8000E-04	5.0000E+06	1.2300E-03	5.1000E+06	1.7000E-03	5.2000E+06	2.1400E-03	5.3000E+06	3.2800E-03
26	5.4000E+06	4.5000E-03	5.5000E+06	5.8000E-03	5.6000E+06	7.1600E-03	5.8000E+06	1.0100E-02	6.0000E+06	1.3200E-02
31	6.2000E+06	1.6400E-02	6.4000E+06	1.9800E-02	6.6000E+06	2.3100E-02	6.8000E+06	2.6400E-02	7.0000E+06	2.9600E-02
36	7.5000E+06	3.7200E-02	8.0000E+06	4.4000E-02	8.5000E+06	5.0400E-02	9.0000E+06	5.6700E-02	9.5000E+06	6.3300E-02
41	1.0000E+07	7.0600E-02	1.0500E+07	7.8700E-02	1.1000E+07	8.7200E-02	1.1500E+07	9.5600E-02	1.2000E+07	1.0300E-01
46	1.2200E+07	1.0600E-01	1.2400E+07	1.0800E-01	1.2600E+07	1.1000E-01	1.2800E+07	1.1200E-01	1.3000E+07	1.1300E-01
51	1.3100E+07	1.1300E-01	1.3200E+07	1.1400E-01	1.3300E+07	1.1400E-01	1.3400E+07	1.1400E-01	1.3500E+07	1.1400E-01
56	1.3600E+07	1.1300E-01	1.3800E+07	1.1300E-01	1.3900E+07	1.1200E-01	1.4100E+07	1.1100E-01	1.4200E+07	1.1000E-01
61	1.4300E+07	1.0900E-01	1.4400E+07	1.0800E-01	1.4500E+07	1.0700E-01	1.4600E+07	1.0400E-01	1.4700E+07	1.0400E-01
66	1.4800E+07	1.0200E-01	1.4900E+07	1.0100E-01	1.5000E+07	9.9400E-02	1.5500E+07	9.0700E-02	1.6000E+07	8.1800E-02
71	1.6500E+07	7.6200E-02	1.7000E+07	6.9200E-02	1.7500E+07	6.3500E-02	1.8000E+07	5.8900E-02	1.8500E+07	5.4700E-02
76	1.9000E+07	5.1300E-02	1.9500E+07	4.9200E-02						


IRON-56
(N,P)
NEUTRON CROSS SECTION
ENDF/B MAT NO. 6410
THRESHOLD
2.97000+ 6 EV
CROSS SECTION-BARNS (TIMES 10^{1})
ENERGY-EV (TIMES 10^{-7})

Evaluation of the $^{58}Fe(n,\gamma)^{59}Fe$ Reaction

For ENDF/B-IV Dosimetry File

R.E. Schenter - October 1973

Hanford Engineering and Development Laboratory

The literature reviewed in this evaluation includes all references in CINDA 72 and its supplements plus the theoretical calculations of Green et al. The thermal value of 1.18 taken from Fabry et al. Resolved resonance parameters for both s and p waves were obtained from Hockenbury et al, and were put into File 2. Above 32 keV the cross section is described in File 3 using the results of a Hauser Feshbach calculation made with the NCAP code of Schmittroth. For these calculations the Moldauer Optical Potential was used with $\Gamma_{\gamma} = 0.200$ and $D_{obs} = 22860$ eV. The NCAP results were lowered 10% to give better agreement with integral results from CFRMF reported by Rogers and Millsap. No microscopic capture measurements above 20 keV have been reported for this isotope.

References

1. Green et al., R-750, RAND,April 1971.
2. Fabry et al., EANDC (E), 76J, (1967).
3. Hockenbury et al., Phys. Rev. 178, 1746 (1969).
4. Hockenbury, RPI Progress Report, April 1973.
5. Schmittroth HEDL-TME 73-30, January 1973.
6. Schmittroth HEDL-TME 71-106, August 1971.
7. Rogers and Millsap HEDL-TME 72-129, ANC-13 (1972).
8. Simons et al., HEDL-TME 72-129, HEDL-17 (1972).

RESONANCE PARAMETERS

```
ISOTOPE-----------------------IRON-58
FRACTIONAL ABUNDANCE--------- 1.0000E+00
NUMBER OF ENERGY RANGES------          1

ENERGY RANGE NUMBER----------          1   RESOLVED SINGLE-LEVEL BREIT-WIGNER PARAMETERS
LOWER ENERGY LIMIT (EV)------ 1.0000E-04
UPPER ENERGY LIMIT (EV)------ 3.2000E+04
NUCLEAR SPIN----------------- 0.0000E+00
SPIN SCATTERING LENGTH (A+)-- 5.0000E-01
NUMBER OF L STATES-----------          2
```

```
L VALUE----------------------          0
NUMBER OF RESONANCES---------          3
SPIN SCATTERING LENGTH (A-)-- 0.0000E+00
```

INDEX	ENERGY (EV)	J VALUE	TOTAL	RESONANCE WIDTHS (EV) NEUTRON	RADIATION	FISSION
1	-2.0000E+02	5.0000E-01	9.5000E-01	7.5000E-01	2.0000E-01	0.0000E+00
2	3.5900E+02	5.0000E-01	2.1750E-01	1.7500E-02	2.0000E-01	0.0000E+00
3	1.9200E+04	5.0000E-01	2.0200E+01	2.0000E+01	2.0000E-01	0.0000E+00

```
L VALUE----------------------          1
NUMBER OF RESONANCES---------          3
SPIN SCATTERING LENGTH (A-)-- 0.0000E+00
```

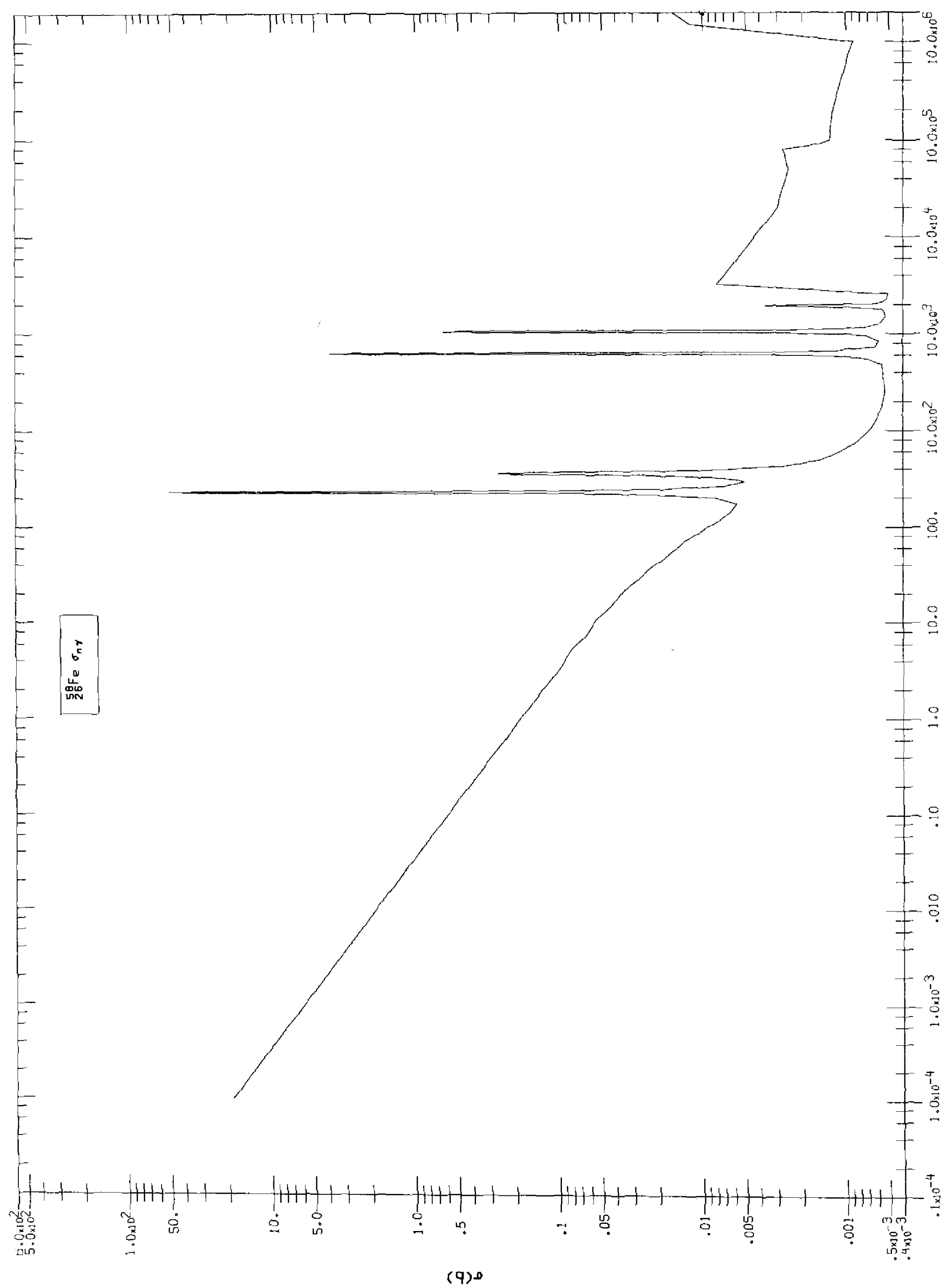
INDEX	ENERGY (EV)	J VALUE	TOTAL	RESONANCE WIDTHS (EV) NEUTRON	RADIATION	FISSION
1	2.3000E+02	1.5000E+00	2.0326E-01	3.2600E-03	2.0000E-01	0.0000E+00
2	6.2000E+03	5.0000E-01	5.2000E+00	5.0000E+00	2.0000E-01	0.0000E+00
3	1.0500E+04	1.5000E+00	1.0200E+01	1.0000E+01	2.0000E-01	0.0000E+00

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION
1 TO 21	LN Y LINEAR IN LN X

NEUTRON CROSS SECTIONS

INDEX,	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	1.0000E-04	7.6000E-01	2.5200E-02	5.0000E-02	2.0000E+02	5.0000E-04	3.2000E+04	5.0000E-04	3.2000E+04	7.9000E-03
6	6.0000E+04	5.6000E-03	1.0000E+05	4.3400E-03	2.0000E+05	2.9600E-03	5.0000E+05	2.5100E-03	7.0000E+05	2.6200E-03
11	8.0000E+05	2.7200E-03	8.2000E+05	2.7300E-03	8.5000E+05	2.0000E-03	9.0000E+05	1.5800E-03	1.0000E+06	1.2900E-03
16	2.0000E+06	1.2200E-03	5.0000E+06	1.2300E-03	7.0000E+06	9.6300E-04	1.0000E+07	8.8200E-04	1.5000E+07	1.2000E-02
21	2.0000E+07	1.6000E-02								



58 26 Fe σnγ
En(eV)
σ(b)

Evaluation of $^{59}Co(n,\gamma)^{60}Co$, $^{59}Co(n,2n)^{58}Co$, $^{59}Co(n\alpha)^{56}Mn$. For ENDF/B-IV

T.J. Krieger, (BNL), A.B. Smith, D.L. Smith (ANL) and
J.D. Jenkins (ORNL)

The present evaluation of Co-59 (n,γ) for ENDF/B IV consists of two parts, an evaluation below 100 KeV by T.J. Krieger, Brookhaven National Laboratory, and one above 100 KeV by A.B. Smith and D.L. Smith, Argonne National Laboratory.

A. $^{59}Co(n,\gamma)$ evaluation below 100 KeV, T.J. Kreiger, BNL.

The Resonance region has been extended from 10^{-5} eV -36 keV in ENDF/B-III to 10^{-5} eV - 100 keV for ENDF/B-IV. However, the list of resonances extends to 119 keV. There is no unresolved region. Care has been taken to tie in smoothly with the evaluation above 100 keV.

The resonance parameters were taken from the recently published new edition of the BNL 325 compilation (Ref. 1) with the following modifications:

(1) The effective scattering radius R' was increased from 5.3f (Ref. 1) to 6.8f in order to improve the fit of the total cross section between resonances with the data of J. Garg et al. (Ref. 2).

(2) The change in R' mentioned above entailed a change in the bound state parameters. These are determined by fitting to the experimental values (Ref. 1) of the thermal scattering and

thermal capture cross sections and of the coherent scattering amplitude.

(3) Unknown J-values were assigned the values 3 or 4 at random, an attempt being made to keep the level density proportional to 2J+1.

(4) To improve the fit with the data of Ref. 2, a few resonances in Ref. 1 were eliminated completely and some in the high energy region were shifted slightly.

(5) Unknown gamma widths (for resonances between 18.92 keV and 90 keV) were assigned the value $\Gamma\gamma$=0.48 eV. Above 90 KeV gamma width was increased to 1.55 eV in order to improve the fit to capture data and to smooth the tie-in with the evaluation above 100 keV.

Using the resonance parameters of Ref. 1 with the above modifications, Breit-Wigner multi-level calculations were performed and compared with the data of Ref. 2. The fit was generally very good. However, for further improvement, a small background contribution (no larger than ±1b below 95 KeV) to the elastic scattering cross section was introduced in selected energy regions of File 3. The capture cross section was not assigned a File 3 background contribution.

The thermal (0.0253 eV) cross section calculated from Files 2 and 3 follows:

Thermal capture cross section = 37.22 barns

This value is within the limits given in Ref. 1.

The resonance capture integral (lower limit = 0.5 eV) calculated from File 2 is 76.7 barns which is within the limits given in Ref. 1.

B. ^{59}Co evaluation 0.1 - 20 MeV, A.B. Smith and D.L. Smith, ANL.*

The (n,γ) Reaction

The cross sections for this process have been measured by activation and by prompt gamma-ray detection techniques. There is a metastable state in the residual ^{60}Co nucleus but the isomer ratio has been determined at a number of incident energies by Paulsen[6] and thus the total (n,γ) cross section can be reasonably deduced using activation techniques. Johnsrud et al.[7] have determined the isomer activation cross section at a number of energies up to ∿ 2.0 MeV. Their results have been corrected to obtain the total (n,γ) cross section using the isomer ratios of Paulsen. Paulsen has measured the (n,γ) cross sections at approximately 2.0, 6.0 and 14 MeV. The Johnsrud et al. and Paulsen measurements are in agreement in the region of overlap near 2.0 MeV. Rigaud et al.[8] determined a 14.8 MeV cross section from observation of prompt gamma-ray emission. Their value is only about half that of Paulsen but both are small (< 2.5mb).

The available experimental information is sparse but it does provide reasonable guidance for the present evaluation illustrated in Fig. 1. The evaluation follows the small structure near 0.5 MeV reported in Ref. 7. The interpolation from measurements at 6.0 to those at 14.0 MeV is essentially linear with little slope. The available experimental information seems to preclude any ap-

*Extracted from P.T. Guenther et al. (Ref. 3).

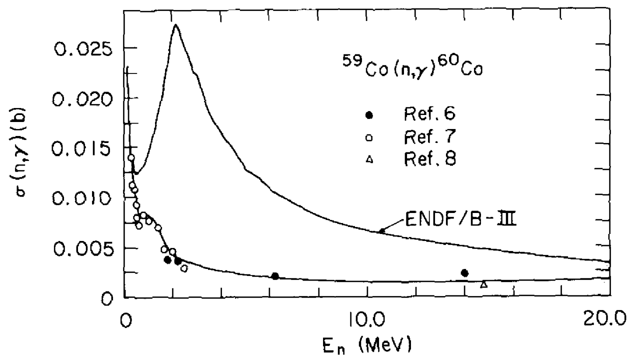


Figure 1

preciable giant resonance behavior between 2.0 and 14.0 MeV. Above 14 MeV the evaluation slowly increases. Such a behavior is qualitatively consistent with a small contribution from direct capture. The evaluation compromises between measured results near 14.0 MeV. The evaluation has some uncertainties but the cross sections are generally small and as a consequence creditable errors will not seriously influence most applications.

The present (n,γ) evaluation is grossly different from that of ENDF, MAT-1118 as illustrated in Fig. 1. No experimental evidence justifying the ENDF-III result over much of the energy range could be found.

The (n,2n) Reaction

The product nucleus, ^{58}Co, has an isomeric state which, fortunately, decays primarily by internal conversion. Thus, with reasonable care, activation methods have been used to give good results.

The available experimental information was divided into three sets. The first of these was judged most reliable by experimental error, detail and consistency, both internally and with other selected sets. In this first group were the results of Cabe et al.(9), Granger and Longneve(10), Bormann et al. (omitting the lowest energy points)(11), Wenusch et al.(12), Bormann et al.(13), Wenusch and Vonach(14), Paulsen and Liskien(15), and Goodwin and Carter(16). The second set of data was given less consideration in the evaluation and consisted of the results of Decowski et al.(17), Weigold et al.(18), and Jeronymo et al.(19). The third set of data, consisting of the results of Refs. 20 to 23, was not accepted for this evaluation due to large discrepancies with the body of available information and/or large uncertainties. In some instances the values of the third set were not reasonably consistent with systematics(24) and/or were obviously much too small. The experimental information of all three sets is summarized in Fig. 2.

Giving most weight to the first data group (above) and, particularly, that of Ref. 15 (as it is detailed and of high

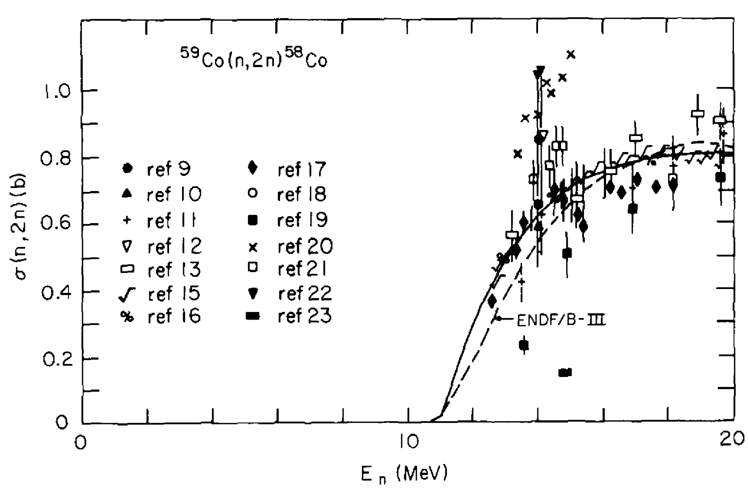


Figure 2

precision) a curve was constructed through the measured values. This curve is representative of experimental values as shown in Fig. 2 and was used in the present evaluation. The choice of this curve was subjective. However, more logical approaches may be deceptive in this instance as some data, reported with the highest precision, are obviously in error. Furthermore, some merit should be given to demonstrated reliability of particular laboratories and/or methods. These are subjective judgments.

Apparently the energies of the emitted neutrons have not been measured. Therefore, we assume an evaporation distribution with a temperature somewhat "softer" than that of the (n,n') process. The present evaluation and that of ENDF, MAT-1118 are compared in Fig. 2. There is not a great deal of difference though the present evaluation clearly is more descriptive of measurements at lower energies.

C. $^{59}Co\ (n\alpha)\ ^{56}Mn$ evaluation, J.D. Jenkins, ORNL.

Several sets of consistent data exist for this reaction. The ENDF/B Version III (MAT 1118) representation follows the general shape of the data at energies above 8 MeV but does not represent the experimental shape below that energy. It is evident from Fig. 3 that the ENDF/B straight line representation from 6.5 to 8 MeV can be improved upon.

Bresesti et al. (Ref. 5) have evaluated this reaction cross section and their evaluation appears on Figs. 3 and 4. It appears to follow the data more closely in the lower energy range and re-

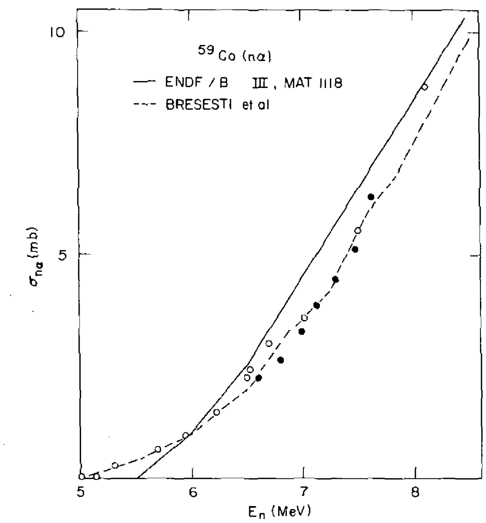


Figure 3

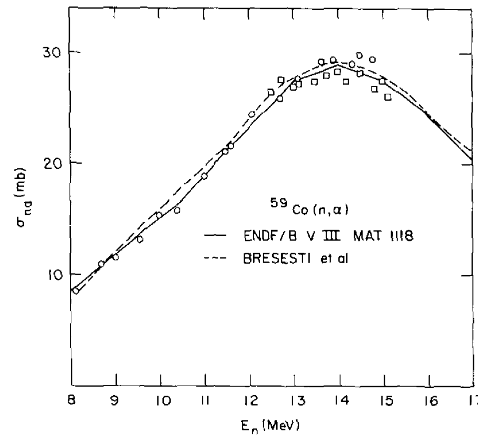


Figure 4

produces the experimental threshold at ∿5 MeV while the ENDF/B evaluation is zero up to 5.5 MeV. At higher energies the Bresesti evaluation and ENDF/B Version III evaluations are similar.

The evaluation of Bresesti et al., therefore is adopted to represent this reaction and replaces the current evaluation of ^{59}Co(n,α) for ENDF/B Version IV.

References

1. S.F. Mughabghab and D.I. Garber, Neutron Cross Sections, Vol. 1, Resonance Parameters, BNL-325, Third Edition, Vol. 1, (June, 1973).

2. J.B. Garg, J. Rainwater and W.W. Havens Jr., B.A.P.S. 8,334 (1963), and Columbia Report CR-1860 (1964). Also, Private Communication, (1965).

3. P.T. Guenther, P.A. Moldauer, A.B. Smith, D.L. Smith, and J.F. Whalen, Cobalt Fast Neutron Cross Sections - Measurement and Evaluation, ANL Report ANL/NDM-1, (July, 1973).

4. A. Wapstra and N. Gove, Nuclear Data A9, 267 (1971).

5. Bresesti et al., Nuc. Sci. and Eng. 40, 331 (1970).

6. A. Paulsen Z fur Phys. 205, 226 (1967).

7. A. Johnsrud, M. Silbert and H. Barschall, Phys. Rev. 116, 927 (1959).

8. F. Rigaud, J.L. Irigaray, G. Pettit, C. Longo and F. Saporetti, Nuc. Phys. A173, 551 (1971).

9. J. Cabe, H. Laurat and P. Yvon, EANDC-49, 83 (1963).

10. B. Granger and M. Longneve, EANDC-49, 82 (1963).

11. M. Bormann, U. Seebeck and W. Voigts, Z. Naturforschung 21A 988 (1966).

12. R. Wenusch et al., Oesterr. Akad. Wiss 99, 1 (1962).

13. M. Bormann, S. Cierjacks, R. Langkau and H. Neuert, Zeits. fur Physik. 166, 477 (1962).

14. R. Wenusch and H. Vonach, Private Communication as quoted by Ref. 60.

15. A. Paulsen and H. Liskien, Jour. Nucl. Energy A/B19, 907 (1965).

16. D. Goodwin and G. Carter, Trans. of ANS 10, 227 (1967).

17. P. Decowski, W. Grochulski, A. Marcinkowski, K. Siwvek, I. Sledzinska and Z. Wilhelmi, Nucl. Phys. A112, 513 (1968).

18. E. Weigold, Australian Jour. Phys. 13, 186 (1960).

19. J. Jeronymo, G. Mani, J. Olkowsky, A. Sadeghi and C. Williamson, Nucl. Phys. 47, 157 (1963).

20. S. Okumura, Nucl. Phys. A93, 74 (1967).

21. E. Weigold and R. Glover, Nucl. Phys. 32, 106 (1962).

22. J. Strain and W. Ross, Oak Ridge National Lab. Report, ORNL-3672 (1965).

23. J. Preiss and R. Fink, Nucl. Phys. 15, 326 (1960).

24. M. Bormann, Nucl. Phys. 65, 257 (1965).

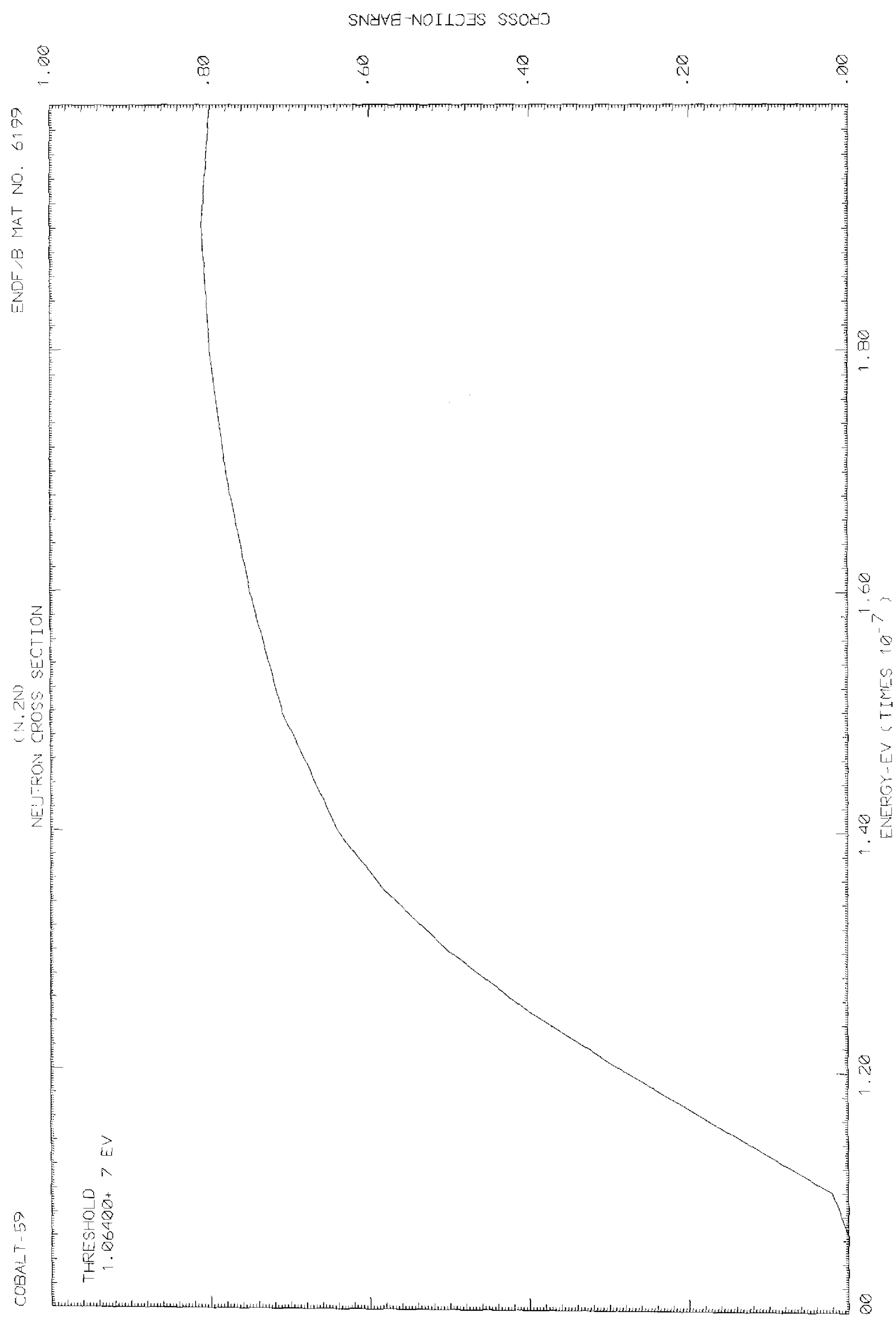
REACTION Q VALUE -1.0461E+07 EV

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION
1 TO 14	Y LINEAR IN X

NEUTRON CROSS SECTIONS

INDEX,	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	1,0640E+07	0,0000E+00	1,1000E+07	2,0000E-02	1,1500E+07	1,5000E-01	1.2000E+07	2.8000E-01	1,2500E+07	4.0000E-01
6	1,3000E+07	5,0000E-01	1,3500E+07	5,8000E-01	1,4000E+07	6,4000E-01	1.5000E+07	7.1000E-01	1,6000E+07	7.5000E-01
11	1,7000E+07	7.8000E-01	1,8000E+07	8,0000E-01	1,9000E+07	8.1000E-01	2,0000E+07	8.0000E-01		


COBALT-59
(N,2N)
NEUTRON CROSS SECTION
ENDF/B MAT NO. 6199
THRESHOLD
1.06400+ 7 EV
CROSS SECTION-BARNS
1.00
.80
.60
.40
.20
.00
1.00
1.20
1.40
1.60
1.80
ENERGY-EV (TIMES 10^-7)

COBALT-59

RESONANCE DATA
RESONANCE PARAMETERS

ISOTOPE--------------------COBALT-59
FRACTIONAL ABUNDANCE---------- 1.0000E+00
NUMBER OF ENERGY RANGES------ 1

ENERGY RANGE NUMBER---------- 1

RESOLVED MULTILEVEL BREIT-WIGNER PARAMETERS

LOWER ENERGY LIMIT (EV)------ 1.0000E-05
UPPER ENERGY LIMIT (EV)------ 1.0000E+05
NUCLEAR SPIN----------------- 3.5000E+00
SPIN SCATTERING LENGTH (A+)-- 6.8000E-01
NUMBER OF L STATES----------- 1

L VALUE---------------------- 0
NUMBER OF RESONANCES--------- 92
SPIN SCATTERING LENGTH (A-)-- 0.0000E+00

			RESONANCE WIDTHS (EV)			
INDEX	ENERGY (EV)	J VALUE	TOTAL	NEUTRON	RADIATION	FISSION
1	-5.2100E+02	3.0000E+00	5.0150E+01	4.9670E+01	4.8000E-01	0.0000E+00
2	1.3200E+02	4.0000E+00	5.6000E+00	5.1200E+00	4.8000E-01	0.0000E+00
3	1.3800E+03	3.0000E+00	4.8560E-01	5.6000E-03	4.8000E-01	0.0000E+00
4	2.8500E+03	4.0000E+00	5.8500E-01	1.0500E-01	4.8000E-01	0.0000E+00
5	3.9800E+03	3.0000E+00	5.7000E-01	9.0000E-02	4.8000E-01	0.0000E+00
6	4.3220E+03	4.0000E+00	1.1048E+02	1.1000E+02	4.8000E-01	0.0000E+00
7	5.0150E+03	3.0000E+00	6.5200E+02	6.5100E+02	1.0000E+00	0.0000E+00
8	6.3800E+03	4.0000E+00	2.2200E+00	2.0000E+00	2.2000E-01	0.0000E+00
9	8.0500E+03	3.0000E+00	3.7300E+01	3.7000E+01	3.0000E-01	0.0000E+00
10	8.7500E+03	4.0000E+00	1.1400E+00	8.2000E-01	3.2000E-01	0.0000E+00
11	9.6900E+03	3.0000E+00	3.2600E+00	2.7000E+00	5.6000E-01	0.0000E+00
12	1.0700E+04	4.0000E+00	6.5530E+01	6.4900E+01	6.3000E-01	0.0000E+00
13	1.1850E+04	3.0000E+00	2.7500E+00	2.5000E+00	2.5000E-01	0.0000E+00
14	1.3280E+04	4.0000E+00	2.1650E+01	2.1000E+01	6.5000E-01	0.0000E+00
15	1.5640E+04	3.0000E+00	7.4570E+01	7.4100E+01	4.7000E-01	0.0000E+00
16	1.6920E+04	4.0000E+00	1.6552E+02	1.6500E+02	5.2000E-01	0.0000E+00
17	1.9750E+04	4.0000E+00	3.2800E+00	2.8000E+00	4.8000E-01	0.0000E+00
18	2.1940E+04	3.0000E+00	7.4543E+02	7.4500E+02	4.8000E-01	0.0000E+00
19	2.2510E+04	4.0000E+00	2.5348E+02	2.5300E+02	4.8000E-01	0.0000E+00
20	2.4460E+04	3.0000E+00	3.6048E+02	3.6000E+02	4.8000E-01	0.0000E+00
21	2.5150E+04	4.0000E+00	1.8448E+02	1.8400E+02	4.8000E-01	0.0000E+00
22	2.5920E+04	4.0000E+00	2.5480E+01	2.5000E+01	4.8000E-01	0.0000E+00
23	2.7350E+04	4.0000E+00	1.7048E+02	1.7000E+02	4.8000E-01	0.0000E+00
24	2.9400E+04	3.0000E+00	1.6480E+01	1.6000E+01	4.8000E-01	0.0000E+00
25	3.0110E+04	4.0000E+00	3.2748E+02	3.2700E+02	4.8000E-01	0.0000E+00
26	3.1360E+04	3.0000E+00	1.5548E+02	1.5500E+02	4.8000E-01	0.0000E+00
27	3.1760E+04	4.0000E+00	8.8800E+00	8.4000E+00	4.8000E-01	0.0000E+00
28	3.2730E+04	3.0000E+00	1.4248E+02	1.4200E+02	4.8000E-01	0.0000E+00
29	3.3050E+04	4.0000E+00	4.4480E+01	4.4000E+01	4.8000E-01	0.0000E+00
30	3.4510E+04	3.0000E+00	6.1800E+00	5.7000E+00	4.8000E-01	0.0000E+00
31	3.4900E+04	4.0000E+00	2.4648E+02	2.4600E+02	4.8000E-01	0.0000E+00
32	3.6740E+04	3.0000E+00	2.6480E+01	2.6000E+01	4.8000E-01	0.0000E+00
33	4.0250E+04	3.0000E+00	2.7480E+01	2.7000E+01	4.8000E-01	0.0000E+00
34	4.0670E+04	4.0000E+00	3.6800E+00	3.2000E+00	4.8000E-01	0.0000E+00
35	4.1480E+04	4.0000E+00	3.6480E+01	3.6000E+01	4.8000E-01	0.0000E+00
36	4.2810E+04	4.0000E+00	3.1800E+00	2.7000E+00	4.8000E-01	0.0000E+00
37	4.3610E+04	3.0000E+00	3.8800E+00	3.4000E+00	4.8000E-01	0.0000E+00
38	4.5230E+04	3.0000E+00	3.2348E+02	3.2300E+02	4.8000E-01	0.0000E+00
39	4.5970E+04	4.0000E+00	3.0048E+02	3.0000E+02	4.8000E-01	0.0000E+00

40	4.7140E+04	4.0000E+00	4.0480E+01	4.0000E+01	4.8000E-01	0.0000E+00
41	5.1260E+04	4.0000E+00	4.8048E+02	4.8000E+02	4.8000E-01	0.0000E+00
42	5.2850E+04	4.0000E+00	5.2380E+01	5.1900E+01	4.8000E-01	0.0000E+00
43	5.3830E+04	3.0000E+00	5.0048E+02	5.0000E+02	4.8000E-01	0.0000E+00
44	5.6450E+04	3.0000E+00	2.0048E+02	2.0000E+02	4.8000E-01	0.0000E+00
45	5.7740E+04	4.0000E+00	1.8480E+01	1.8000E+01	4.8000E-01	0.0000E+00
46	5.8940E+04	3.0000E+00	3.4148E+02	3.4100E+02	4.8000E-01	0.0000E+00
47	5.9760E+04	4.0000E+00	1.0008E+02	9.9600E+01	4.8000E-01	0.0000E+00
48	6.1080E+04	3.0000E+00	9.1480E+01	9.1000E+01	4.8000E-01	0.0000E+00
49	6.2800E+04	4.0000E+00	3.9480E+01	3.9000E+01	4.8000E-01	0.0000E+00
50	6.6040E+04	3.0000E+00	8.7480E+01	8.7000E+01	4.8000E-01	0.0000E+00
51	6.9510E+04	4.0000E+00	2.0480E+01	2.0000E+01	4.8000E-01	0.0000E+00
52	6.9960E+04	4.0000E+00	2.1048E+02	2.1000E+02	4.8000E-01	0.0000E+00
53	7.1870E+04	3.0000E+00	4.1648E+02	4.1600E+02	4.8000E-01	0.0000E+00
54	7.2310E+04	3.0000E+00	2.1948E+02	2.1900E+02	4.8000E-01	0.0000E+00
55	7.4470E+04	4.0000E+00	4.4800E+00	4.0000E+00	4.8000E-01	0.0000E+00
56	7.4730E+04	4.0000E+00	3.6480E+01	3.6000E+01	4.8000E-01	0.0000E+00
57	7.5700E+04	3.0000E+00	1.1480E+01	1.1000E+01	4.8000E-01	0.0000E+00
58	7.5890E+04	4.0000E+00	9.4800E+00	9.0000E+00	4.8000E-01	0.0000E+00
59	7.6530E+04	3.0000E+00	2.1480E+01	2.1000E+01	4.8000E-01	0.0000E+00
60	7.7000E+04	3.0000E+00	4.0048E+02	4.0000E+02	4.8000E-01	0.0000E+00
61	7.7720E+04	4.0000E+00	9.4800E+00	9.0000E+00	4.8000E-01	0.0000E+00
62	7.8780E+04	3.0000E+00	1.1480E+01	1.1000E+01	4.8000E-01	0.0000E+00
63	7.9450E+04	4.0000E+00	2.4948E+02	2.4900E+02	4.8000E-01	0.0000E+00
64	8.1650E+04	3.0000E+00	2.2948E+02	2.2900E+02	4.8000E-01	0.0000E+00
65	8.3140E+04	3.0000E+00	2.1948E+02	2.1900E+02	4.8000E-01	0.0000E+00
66	8.4200E+04	4.0000E+00	2.1248E+02	2.1200E+02	4.8000E-01	0.0000E+00
67	8.6290E+04	3.0000E+00	2.3480E+01	2.3000E+01	4.8000E-01	0.0000E+00
68	8.8800E+04	4.0000E+00	1.1565E+03	1.1560E+03	4.8000E-01	0.0000E+00
69	8.9050E+04	4.0000E+00	2.7480E+01	2.7000E+01	4.8000E-01	0.0000E+00
70	9.1510E+04	3.0000E+00	3.6500E+01	3.5000E+01	1.5000E+00	0.0000E+00
71	9.2700E+04	4.0000E+00	3.3950E+02	3.3800E+02	1.5000E+00	0.0000E+00
72	9.2780E+04	3.0000E+00	2.6985E+03	2.6970E+03	1.5000E+00	0.0000E+00
73	9.4800E+04	4.0000E+00	4.2850E+02	4.2700E+02	1.5000E+00	0.0000E+00
74	9.5110E+04	3.0000E+00	8.6500E+01	8.5000E+01	1.5000E+00	0.0000E+00
75	9.7630E+04	3.0000E+00	5.9550E+02	5.9400E+02	1.5000E+00	0.0000E+00
76	9.8300E+04	4.0000E+00	2.9885E+03	2.9870E+03	1.5000E+00	0.0000E+00
77	1.0028E+05	3.0000E+00	1.3150E+02	1.3000E+02	1.5000E+00	0.0000E+00
78	1.0164E+05	3.0000E+00	3.4450E+02	3.4300E+02	1.5000E+00	0.0000E+00
79	1.0533E+05	3.0000E+00	2.5250E+02	2.5100E+02	1.5000E+00	0.0000E+00
80	1.0663E+05	4.0000E+00	2.3050E+02	2.2900E+02	1.5000E+00	0.0000E+00
81	1.0883E+05	3.0000E+00	2.5250E+02	2.5100E+02	1.5000E+00	0.0000E+00
82	1.1005E+05	4.0000E+00	1.4350E+02	1.4200E+02	1.5000E+00	0.0000E+00
83	1.1095E+05	3.0000E+00	9.2500E+01	9.1000E+01	1.5000E+00	0.0000E+00
84	1.1140E+05	4.0000E+00	1.9500E+01	1.8000E+01	1.5000E+00	0.0000E+00
85	1.1212E+05	3.0000E+00	1.4350E+02	1.4200E+02	1.5000E+00	0.0000E+00
86	1.1321E+05	4.0000E+00	1.3450E+02	1.3300E+02	1.5000E+00	0.0000E+00
87	1.1411E+05	3.0000E+00	1.9500E+01	1.8000E+01	1.5000E+00	0.0000E+00
88	1.1487E+05	3.0000E+00	1.2125E+03	1.2110E+03	1.5000E+00	0.0000E+00
89	1.1644E+05	4.0000E+00	9.0500E+01	8.9000E+01	1.5000E+00	0.0000E+00
90	1.1726E+05	4.0000E+00	6.0550E+02	6.0400E+02	1.5000E+00	0.0000E+00
91	1.1863E+05	3.0000E+00	1.3955E+03	1.3940E+03	1.5000E+00	0.0000E+00
92	1.1940E+05	4.0000E+00	4.1040E+02	4.0890E+02	1.5000E+00	0.0000E+00

COBALT-59 | (N,GAMMA) NEUTRON CROSS SECTION | ENDF/B MATERIAL NO. 6199

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION
1 TO 21	Y LINEAR IN X

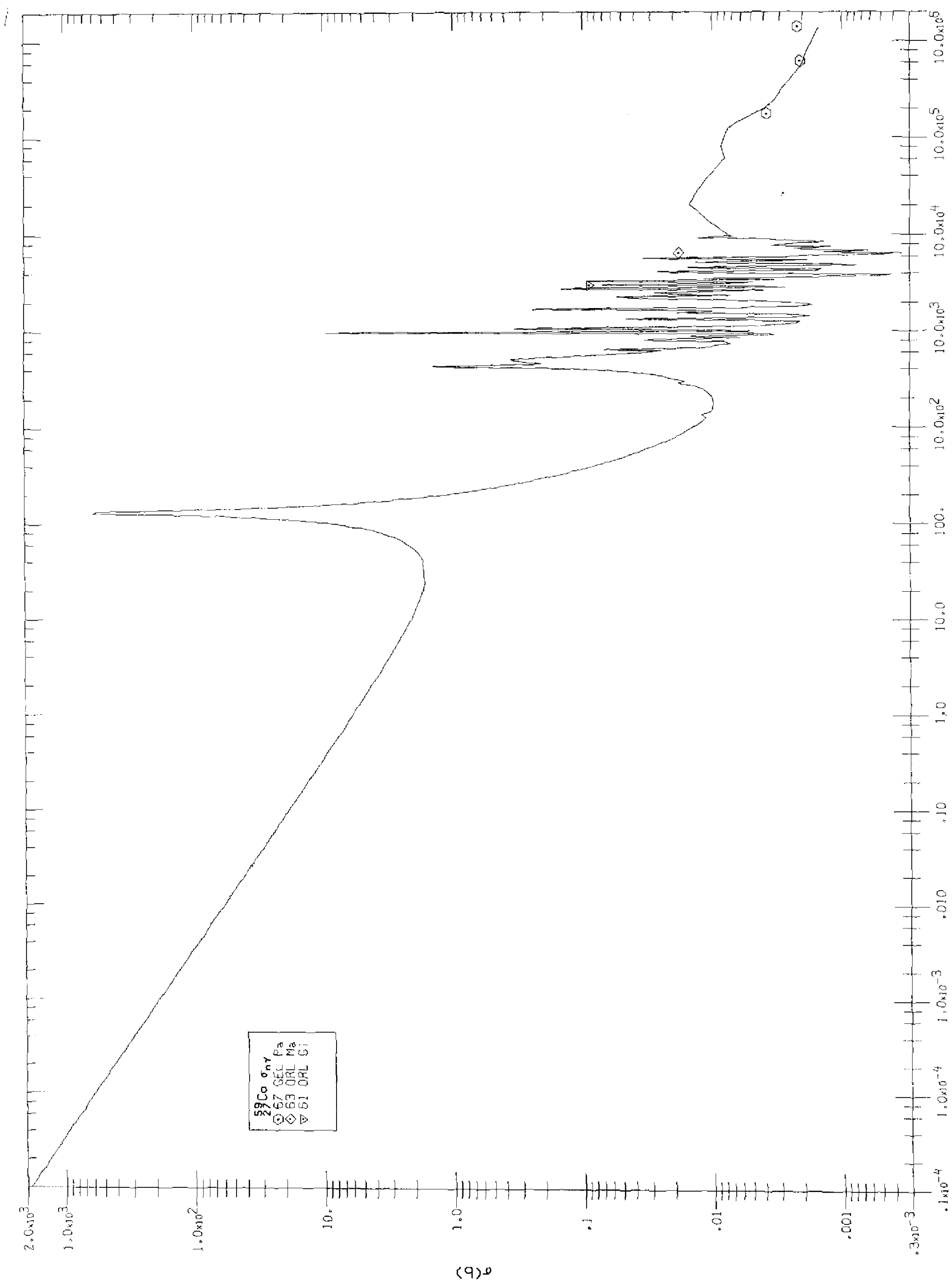
NEUTRON CROSS SECTIONS

INDEX,	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	1.0000E-05	0.0000E+00	1.0000E+00	0.0000E+00	1.0000E+05	0.0000E+00	1.0000E+05	2.2500E-02	2.0000E+05	1.5000E-02
6	3.0000E+05	1.2500E-02	5.0000E+05	9.0000E-03	6.0000E+05	8.0000E-03	7.0000E+05	8.0000E-03	8.0000E+05	8.5000E-03
11	9.0000E+05	8.4000E-03	1.2500E+06	7.6000E-03	1.5000E+06	6.2000E-03	1.7500E+06	4.8000E-03	2.0000E+06	4.0000E-03
16	2.5000E+06	3.3000E-03	4.0000E+06	2.5000E-03	6.0000E+06	2.0000E-03	1.0000E+07	1.7000E-03	1.4000E+07	1.5000E-03
21	2.0000E+07	1.5000E-03								

REFERENCES FOR EXPERIMENTAL DATA

^{59}Co(n,γ)

Yr.	Lab	Author	References
72	MOL	Deworm	Priv. Comm. (1972)
67	GEL	Paulsen	Z. für Phys. 205, 226 (1967)
66	GEL	Vaninbroukx	Nuc. Sci. & Eng. 24, 87 (1967)
65	FAR	Carré	EANDC-(E)-57, 171 (1965)
63	ORL	Macklin, et al.	Phys. Rev. 129, 2695 (1963)
61	BUC	Stephanescu, et al.	Reactor Conf. Bucharest, p. 553 (1961)
61	ANL	Meadows, et al.	Nuc. Sci. & Eng. 9, 132 (1961)
61	ORL	Gibbons, et al.	Phys. Rev. 122, 182 (1961)
60	MUN	Wolf	Nuk, 2, 255 (1960)
52	FAR	Ailloud, et al.	J. Phys. Rad. 13, 171 (1952)
51	BNL	Deutsch, et al.	Phys. Rev. 83, 1059 (1951)


59/27Co σnγ
⊙ 67 GEL Pa
◇ 63 ORL Ma
▽ 61 ORL Gi
En(eV)
σ(b)

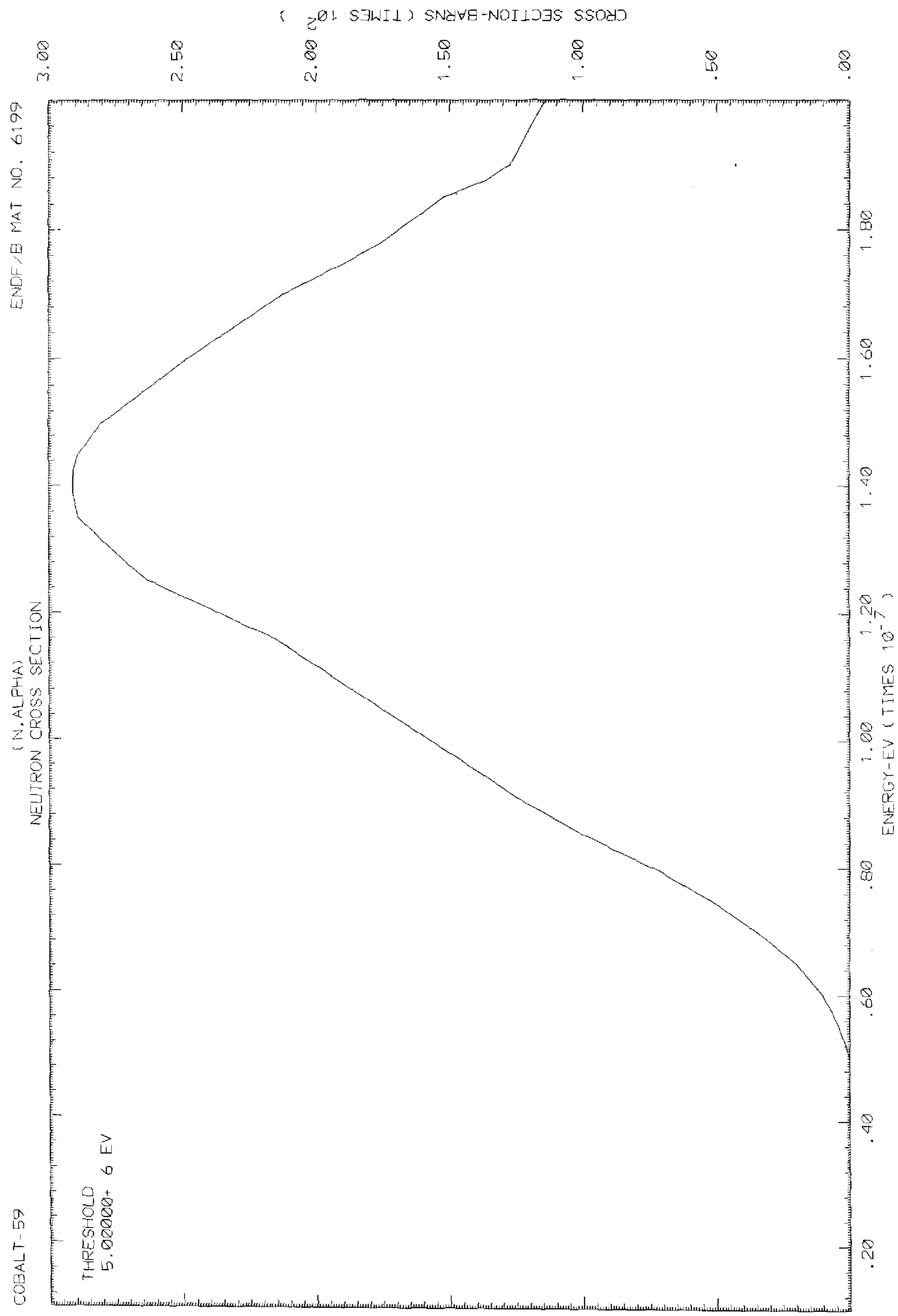
REACTION Q VALUE 3.1780E+05 EV

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION
1 TO 26	Y LINEAR IN X

NEUTRON CROSS SECTIONS

INDEX,	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	5.0000E+06	0.0000E+00	5.5000E+06	4.0000E-04	6.0000E+06	1.0000E-03	6.5000E+06	2.0000E-03	7.0000E+06	3.5000E-03
6	7.5000E+06	5.2500E-03	8.0000E+06	7.4000E-03	8.5000E+06	9.9000E-03	9.0000E+06	1.2100E-02	1.1600E+07	2.1600E-02
11	1.2500E+07	2.6300E-02	1.2750E+07	2.7000E-02	1.3100E+07	2.7900E-02	1.3500E+07	2.8900E-02	1.3850E+07	2.9100E-02
16	1.4250E+07	2.9100E-02	1.4500E+07	2.8900E-02	1.5000E+07	2.8000E-02	1.6000E+07	2.4800E-02	1.7000E+07	2.1200E-02
21	1.7500E+07	1.8800E-02	1.7750E+07	1.7700E-02	1.8500E+07	1.5200E-02	1.8750E+07	1.3700E-02	1.9000E+07	1.2700E-02
26	2.0000E+07	1.1400E-02								


COBALT-59
(N,ALPHA)
NEUTRON CROSS SECTION
ENDF/B MAT NO. 6199
THRESHOLD
5.00000+ 6 EV
CROSS SECTION-BARNS (TIMES 10^2)
3.00
2.50
2.00
1.50
1.00
.50
.00
ENERGY-EV (TIMES 10^7)
.20
.40
.60
.80
1.00
1.20
1.40
1.60
1.80

^{58}Ni (n,2n)^{57}Ni Reaction for ENDF/B-IV*

M. R. Bhat

NNCSC

Brookhaven National Laboratory

There are extensive data on the (n,2n) cross-section of ^{58}Ni from its threshold of 12.415 MeV to 20 MeV. The most extensive data covering a wide range are by Paulsen and Liskien[1] and by Bormann et al.[2] Paulsen determined the (n,2n) cross-section from 12.98 to 19.6 MeV by the activation method and the measurement of the annihilation radiation with an accuracy of about 7%. The activation experiments of Bormann measured the gamma and positron activities with a NaI(Tl) detector and a γ-γ coincidence spectrometer and have a comparable accuracy and extend from 12.95 to 19.6 MeV. As can be seen from Fig. 1, though these two sets of data are in good agreement with one another below 16 MeV, they diverge above this energy with the Paulsen data being larger by as much as 12% or approximately two standard deviations. Two other data sets which extend up to 20.0 MeV; one by Prestwood and Bayhurst[3] and the other by Jeronymo et al.[4]. Prestwood and Bayhurst counted the ^{57}Ni β particles and used ^{238}U fission cross-sections to monitor the neutron flux. These data agree with the general trend of other measurements up to about 14.0 MeV; above this energy

*Extracted from "Neutron and Gamma Ray Production Cross-Sections for Nickel" BNL 50435 October 1974 M.R. Bhat.

they are higher giving 77.4 mb at 19.8 MeV. These cross-sections were considered too high and were not included in the evaluation. The Jeronymo data obtained by measuring the gamma rays following the decay of ^{57}Ni give a cross-section of about 40 mb at 20 MeV and are considered too low to merit consideration (not shown in Fig. 1). The data of Lu and Fink[5] at 14.4 MeV and Cross et al.[6] at 14.5 MeV are higher than other data at this energy. The data of Csikai[7] (not shown) between 13.56 and 14.71 MeV appear to be higher than other measurements and also show a peculiar trend at variance with other experiments (see the plot in Ref. 8 p. 28-58-4) and were not considered in the evaluation. Other data sets shown in the plot are by Temperley[9] and by Barrall et al.[10-12]. Temperley measured the annihilation radiation from the decay of ^{57}Ni and the data are in good agreement with other measurements in the energy region 13.72 to 14.79 MeV. Barrall and co-workers obtained 30.9 ± 2.0 mb at 14.5 ± .2 MeV, 33.4 ± 2.0 mb at 14.6 ± 1.2 MeV, and 36.0 ± 3.0 mb and 14.8 MeV in good agreement with other data sets. Rayburn[13] measured the (n,2n) cross-section as 34.2 ± 2.6 mb at 14.4 ± .3 MeV based on ^{63}Cu (n,2n) = 503 mb. In the ENDF/B-III MAT = 1085 evaluation this cross-section is found to be 533 mb. Therefore, a renormalized value of 36.2 ± 2.7 mb is obtained which is slightly higher than other data at this energy. Preiss and Fink[14] obtained 52 ± 5 mb at 14.8 ± .9 MeV using ^{63}Cu (n,2n) = 556 mb as the standard cross-section; this value appears to be too high. Bramlett and Fink[15] obtain 31.6 ± 4.0 mb at 14.7 ± .2 after their value is renormalized to

^{27}Al (n,α) = 116.1 mb, and is a little on the low side. In addition, Glover and Weigold's[16] measurements follow the general trend of other data except for the last two points at 14.77 MeV and 14.88 MeV. Some of these data were not plotted in Fig. 1 for fear of cluttering up the diagram. After considering all these data, a smooth curve was drawn through these data points with the curve following the general trend of the Bormann data at higher energies and lies lower than the Paulsen measurements and higher than the Bormann data. In Fig. 1 the dashed line shows the (n,2n) cross-section as calculated using the code THRESH[17] which uses systematies of nuclear data to calculate the various (n, particle) cross-sections.

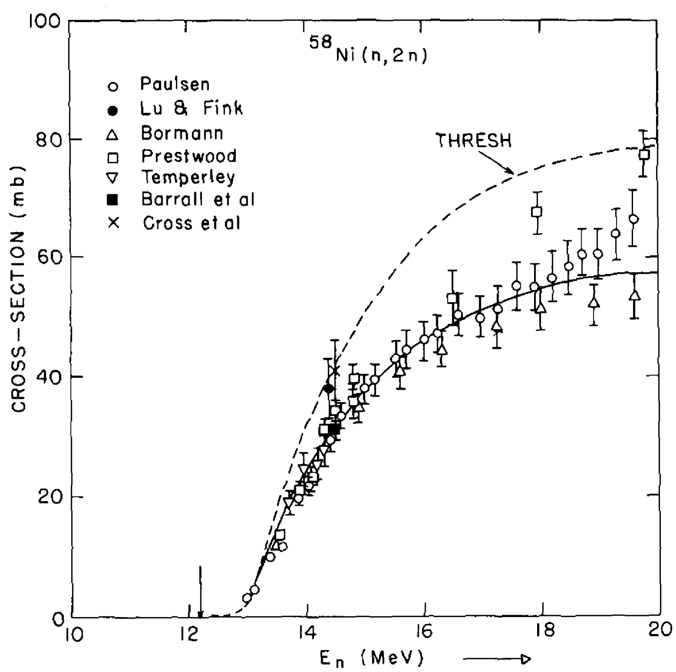


Figure 1

References

1. A. Paulsen and H. Liskien Nuk 7, 117 (1965).

2. M. Bormann, F. Dreyer and V. Zielinski EANDC (E) 66, 42 (1966).

3. R. J. Prestwood and B. P. Bayhurst, Phys. Rev. 121, 1438 (1961).

4. J. M. F. Jeronymo, G. S. Marri, J. Olkowsky, A. Sadeghi and G. F. Williamson, Nucl. Phys. 47, 157 (1963).

5. Wen-deh Lu and R. W. Fink, Phys. Rev. C/4, 1173 (1971).

6. W. G. Cross, R. L. Clarke, K. Morin, G. Slinn, N. M. Ahmed and K. Beg, Bull. American Phys. Soc. Ser. II, 7, 335 (1962).

7. J. Csikai EANDC-50, 2 (1965), Conf on Study of Nuclear Structure with Neutrons, Antwerp, paper 102 (1965).

8. M. D. Goldberg, S. F. Mughabghab, B. A. Magurno and V. M. May, BNL-325, Second Ed. Supplement No. 2, II-A, (1966).

9. J. K. Temperley, Nucl. Sci. & Engineering 32, 195 (1968).

10. R. C. Barrall, M. Silbergeld and D. G. Gardner, Nucl. Phys. A138, 387 (1969).

11. R. C. Barrall, M. Silbergeld and D. G. Gardner SUPH-69-2 (1969).

12. R. C. Barrall, J. A. Holmes and M. Silbergeld AFWL-TR-68-134 (1969) CSISRS AN/SN-10022/14.

13. L. A. Rayburn, Phys. Rev. 122, 168 (1961).

14. I. L. Preiss and R. W. Fink, Nucl. Phys. 15, 326 (1960).

15. E. T. Bramlett and R. W. Fink, Phys. Rev. 131, 2649 (1963).

16. R. N. Glover and E. Weigold, Nucl. Phys. 29, 309 (1962).

17. S. Pearlstein, Journ. Nucl. Energy 27, 81 (1973).

NICKEL-58 DIRECT(N,2N) NEUTRON CROSS SECTION ENDF/B MATERIAL NO. 6419

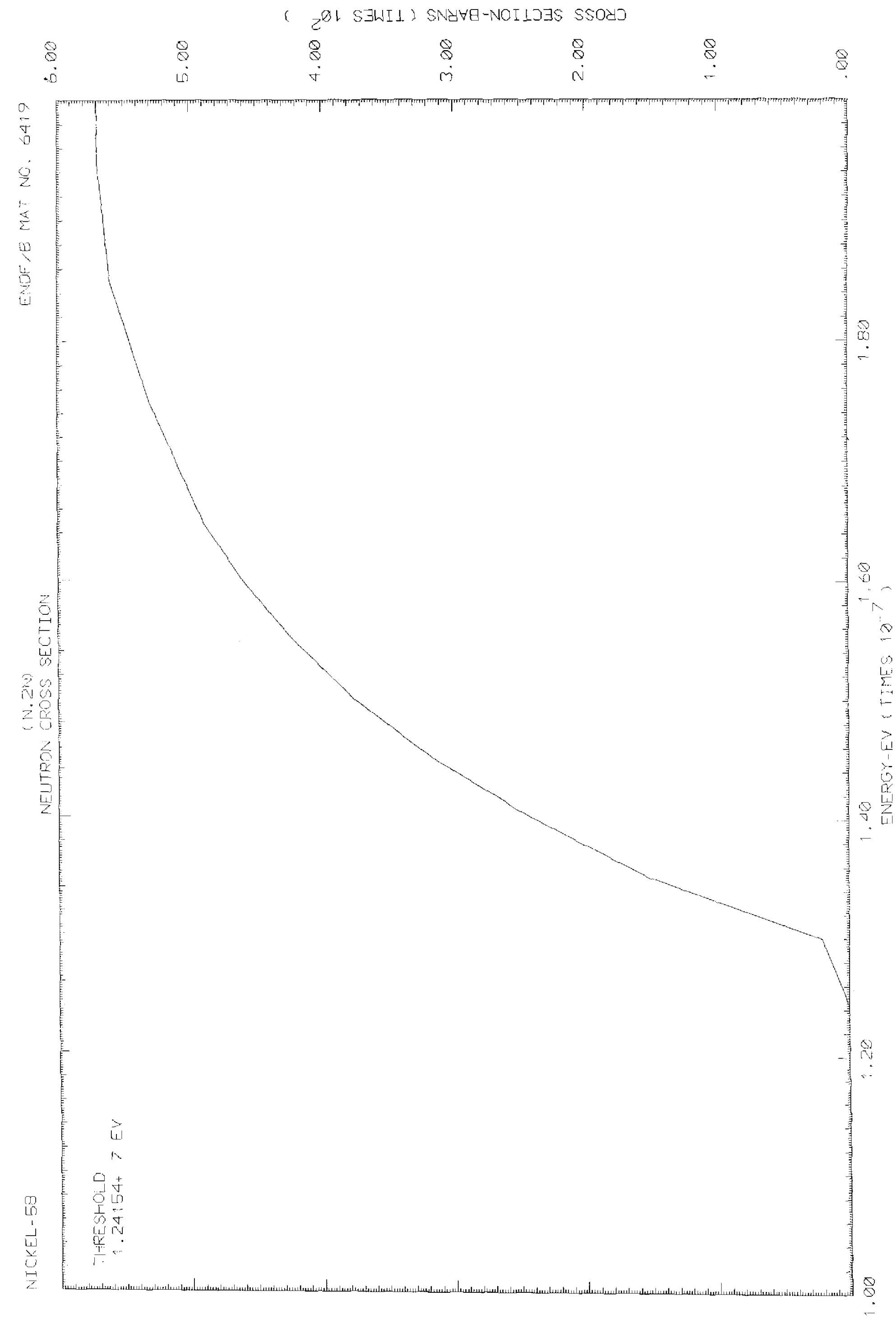
REACTION Q VALUE -1.2203E+07 EV

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION
1 TO 17	Y LINEAR IN X

NEUTRON CROSS SECTIONS

INDEX,	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	1.2415E+07	0.0000E+00	1.2500E+07	2.2300E-04	1.3000E+07	2.0500E-03	1.3500E+07	1.5000E-02	1.4000E+07	2.4000E-02
6	1.4500E+07	3.1500E-02	1.5000E+07	3.7500E-02	1.5500E+07	4.2200E-02	1.6000E+07	4.6000E-02	1.6500E+07	4.9000E-02
11	1.7000E+07	5.1000E-02	1.7500E+07	5.3000E-02	1.8000E+07	5.4500E-02	1.8500E+07	5.6000E-02	1.9000E+07	5.6500E-02
16	1.9500E+07	5.7000E-02	2.0000E+07	5.7000E-02						


NICKEL-58
THRESHOLD
1.24154+ 7 EV
(N,2N)
NEUTRON CROSS SECTION
ENDF/B MAT NO. 6419
CROSS SECTION-BARNS (TIMES 10^-2)
6.00
5.00
4.00
3.00
2.00
1.00
.00
1.00
1.20
1.40
1.60
1.80
ENERGY-EV (TIMES 10^7)

Evaluation of the $^{58}Ni(n,p)^{58}Co$ Reaction

for ENDF/B-III Dosimetry File

R.E. Schenter - August 1973

Hanford Engineering and Development Laboratory

The literature reviewed in this evaluation includes all references in CINDA 72 and its supplements plus papers describing recent measurements by Smith and Meadows and Paulsen and Widera. Fig. 1-5 show the evaluation made (solid curve) together with available experimental data and some previous evaluations. Below 6.0 MeV Smith and Meadows values were directly used (Figs. 1-3). Smith and Meadows results were normalized relative to the ENDF/B-III ^{235}U fission cross section. Above 6.0 MeV a smooth "eye-guide" curve was constructed (Figs. 4-5) which fell between previous evaluations and numerous experimental results.

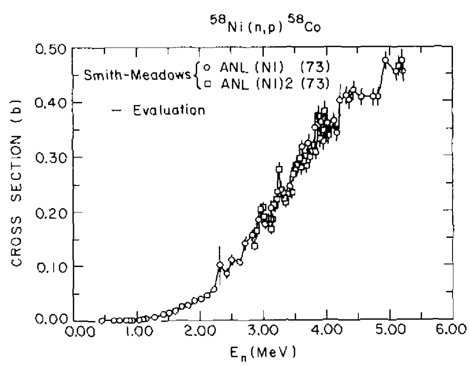


Figure 1

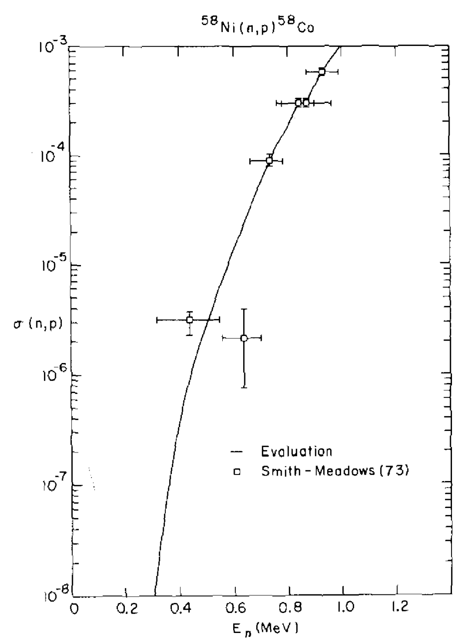


Figure 2

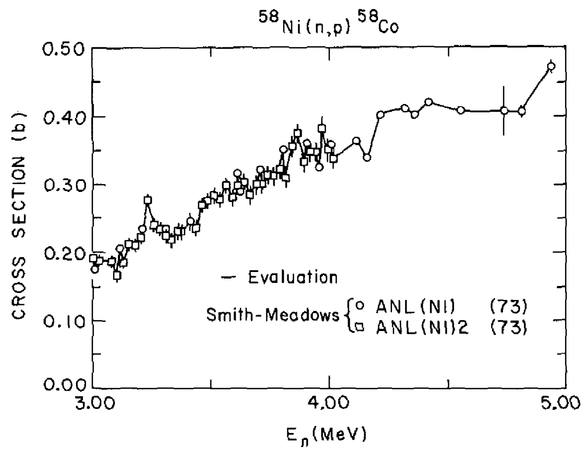


Figure 3

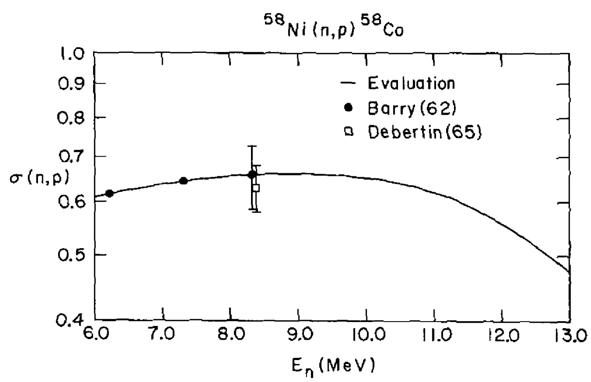
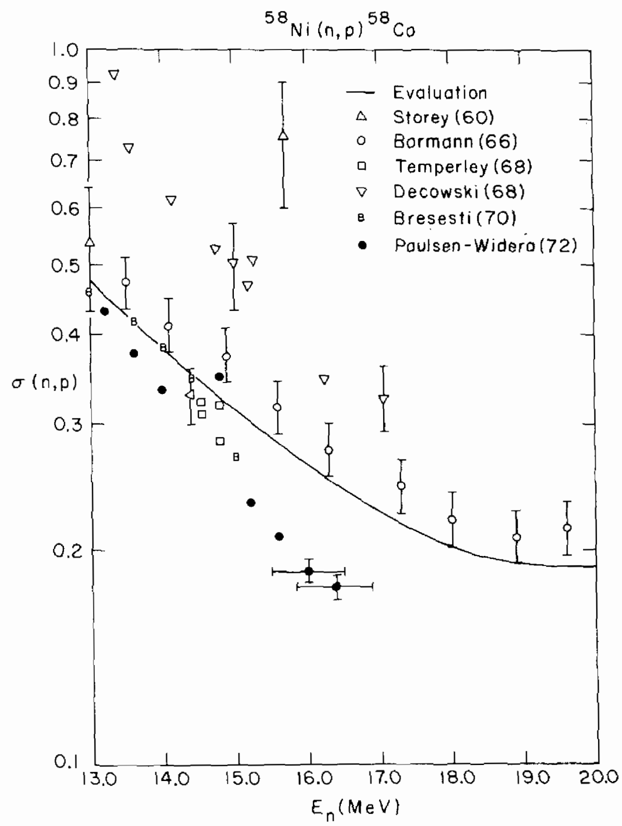


Figure 4



$^{58}Ni(n,p)^{58}Co$
Evaluation
Storey (60)
Bormann (66)
Temperley (68)
Decowski (68)
Bresesti (70)
Paulsen-Widera (72)
σ (n,p)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
E_n(MeV)

Figure 5

References

1. Smith and Meadows, Trans. Am. Nucl. Soc. 16, 1 (1973).
2. Paulsen and Widera, EANDC (E) 150U, 1972.
3. Fabry et al., EANDC (E) 127U, 1970.
4. Simons et al., BNWL-1312, 1970.
5. Bresesti, Nuc. Sci. and Eng. 40, 331 (1970).
6. Barrall et al., Nuc. Phys. A138, 387 (1969).
7. Temperley, Nucl Sci. and Eng. 32, 195 (1968).
8. Decowski et al., Nuc. Phys. A112, 513 (1968).
9. Okumupa, Nuc. Phys. A93, 74 (1967).
10. Bormann et al., Z. Naturforsch, 21A, 988 (1966).
11. Debertin et al., Nuc. Phys. 70, 89 (1965).
12. Konijn et al., Nuc. Phys. 48, 191 (1963).
13. Nakai et al., J. Phys. Soc. Japan, 17, 1215 (1962).
14. Glover et al., Nuc. Phys. 29, 309 (1962).
15. Cross et al., AECL 1542 (1962).
16. Barry et al., J. Nuc. Energy Parts A/B, 16, 467 (1962).
17. Storey et al., Proc. Phys. Soc. 75, 526, (1960).
18. Gonzalez et al., Phys. Rev. 120, 1319 (1960).

NICKEL-58 (N,P) NEUTRON CROSS SECTION ENDF/B MATERIAL NO. 6419

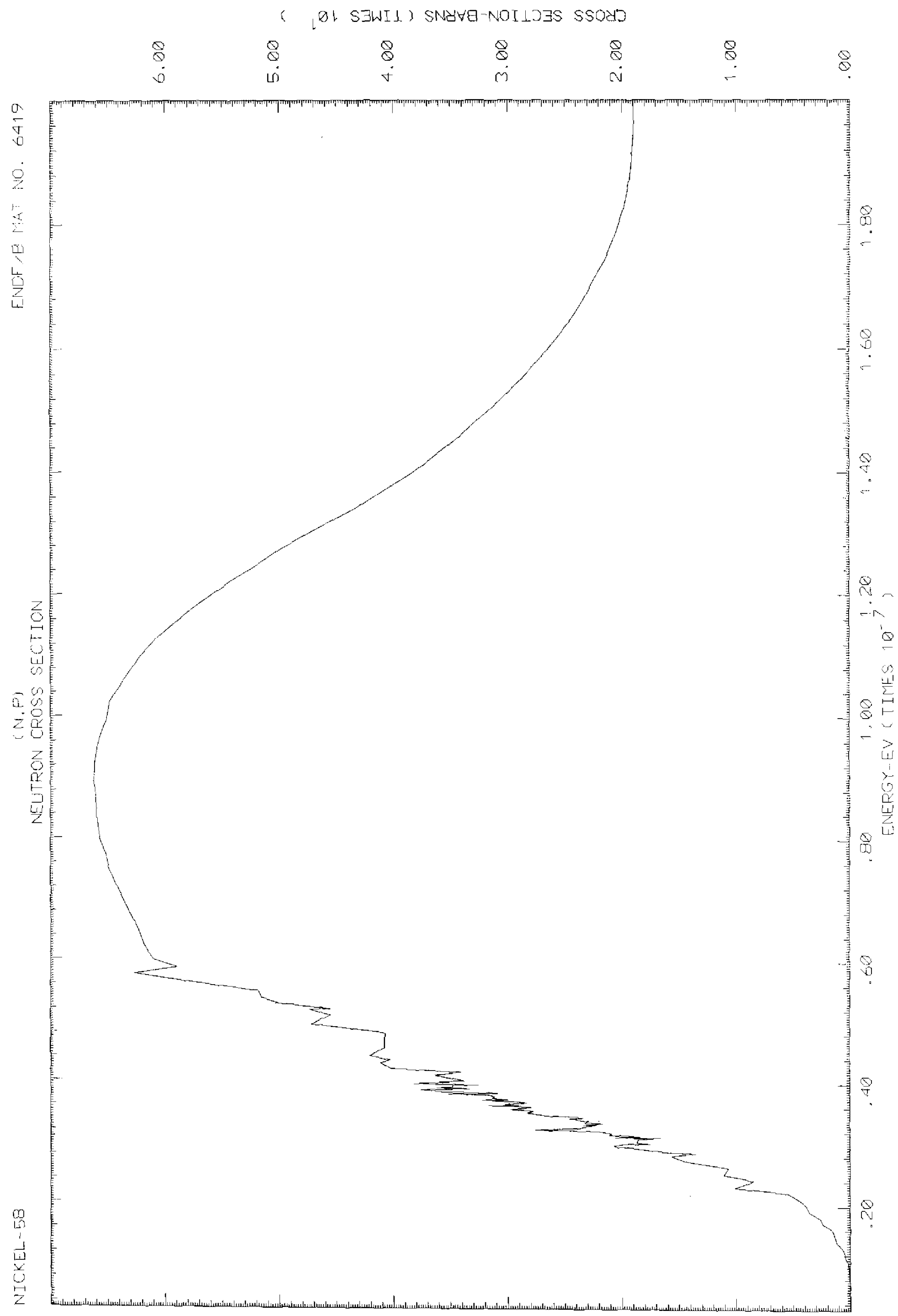
REACTION Q VALUE 3.9470E+05 EV

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION
1 TO 168	LN Y LINEAR IN X

NEUTRON CROSS SECTIONS

INDEX,	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	3.0000E+05	1.0000E-08	3.5000E+05	7.0000E-08	4.0000E+05	4.0000E-07	4.5000E+05	1.3000E-06	5.0000E+05	3.0000E-06
6	5.5000E+05	6.5000E-06	6.0000E+05	1.4000E-05	6.5000E+05	3.0000E-05	7.0000E+05	5.8000E-05	7.2400E+05	8.8362E-05
11	8.3800E+05	3.0390E-04	8.7200E+05	3.0591E-04	9.3000E+05	5.7972E-04	1.0380E+06	1.0832E-03	1.0990E+06	2.3470E-03
16	1.1380E+06	3.5605E-03	1.2760E+06	5.5464E-03	1.4070E+06	1.1534E-02	1.5030E+06	1.3139E-02	1.6070E+06	1.5747E-02
21	1.7050E+06	2.3871E-02	1.8030E+06	2.6378E-02	1.9040E+06	3.5104E-02	2.0050E+06	3.8213E-02	2.1060E+06	4.5635E-02
26	2.2120E+06	5.5063E-02	2.2930E+06	1.0030E-01	2.4140E+06	8.3949E-02	2.5050E+06	1.1033E-01	2.6150E+06	1.0631E-01
31	2.7120E+06	1.4142E-01	2.8130E+06	1.5546E-01	2.8540E+06	1.3440E-01	2.8780E+06	1.6248E-01	2.9040E+06	1.7452E-01
36	2.9240E+06	1.8354E-01	2.9560E+06	2.0260E-01	2.9830E+06	2.0661E-01	3.0060E+06	1.8956E-01	3.0150E+06	1.7452E-01
41	3.0310E+06	1.8655E-01	3.0820E+06	1.8555E-01	3.1070E+06	1.6549E-01	3.1180E+06	2.0561E-01	3.1320E+06	1.8354E-01
46	3.1580E+06	2.1062E-01	3.1830E+06	2.0862E-01	3.2080E+06	2.2065E-01	3.2150E+06	2.3470E-01	3.2350E+06	2.7582E-01
51	3.2610E+06	2.3871E-01	3.2860E+06	2.3269E-01	3.3120E+06	2.2166E-01	3.3130E+06	2.3369E-01	3.3350E+06	2.1564E-01
56	3.3610E+06	2.3169E-01	3.3780E+06	2.2868E-01	3.4110E+06	2.4272E-01	3.4150E+06	2.4573E-01	3.4380E+06	2.3369E-01
61	3.4640E+06	2.6679E-01	3.4880E+06	2.7381E-01	3.5140E+06	2.8284E-01	3.5400E+06	2.7682E-01	3.5640E+06	2.9688E-01
66	3.5950E+06	2.7883E-01	3.6140E+06	2.9588E-01	3.6160E+06	3.1594E-01	3.6230E+06	2.8986E-01	3.6410E+06	3.0189E-01
71	3.6660E+06	2.8284E-01	3.6910E+06	2.9889E-01	3.7110E+06	3.2195E-01	3.7170E+06	2.9889E-01	3.7410E+06	3.1293E-01
76	3.7660E+06	3.1092E-01	3.7930E+06	3.1995E-01	3.8070E+06	3.5104E-01	3.8170E+06	3.0791E-01	3.8420E+06	3.5505E-01
81	3.8670E+06	3.7511E-01	3.8940E+06	3.3198E-01	3.9060E+06	3.6107E-01	3.9180E+06	3.4703E-01	3.9430E+06	3.4703E-01
86	3.9600E+06	3.2496E-01	3.9690E+06	3.8113E-01	3.9940E+06	3.5004E-01	4.0080E+06	3.5906E-01	4.0190E+06	3.3700E-01
91	4.1170E+06	3.6307E-01	4.1610E+06	3.4001E-01	4.2150E+06	4.0119E-01	4.3190E+06	4.1122E-01	4.3590E+06	4.0219E-01
96	4.4210E+06	4.2024E-01	4.5540E+06	4.0721E-01	4.7370E+06	4.0721E-01	4.8100E+06	4.0721E-01	4.9380E+06	4.7240E-01
101	5.1020E+06	4.5435E-01	5.1380E+06	4.6438E-01	5.1930E+06	4.7340E-01	5.1970E+06	4.5435E-01	5.2910E+06	5.0349E-01
106	5.2950E+06	5.0048E-01	5.3730E+06	5.1553E-01	5.4890E+06	5.1853E-01	5.6810E+06	5.9577E-01	5.7730E+06	6.2686E-01
111	5.8700E+06	5.8874E-01	6.0000E+06	6.1000E-01	6.2500E+06	6.1800E-01	6.5000E+06	6.2300E-01	6.7500E+06	6.3000E-01
116	7.0000E+06	6.3700E-01	7.2500E+06	6.4300E-01	7.5000E+06	6.4900E-01	7.7500E+06	6.5200E-01	8.0000E+06	6.5700E-01
121	8.2500E+06	6.5900E-01	8.5000E+06	6.6000E-01	8.7500E+06	6.6100E-01	9.0000E+06	6.6200E-01	9.2500E+06	6.6100E-01
126	9.5000E+06	6.5900E-01	9.7500E+06	6.5500E-01	1.0000E+07	6.5000E-01	1.0250E+07	6.4800E-01	1.0500E+07	6.3900E-01
131	1.0750E+07	6.3000E-01	1.1000E+07	6.2100E-01	1.1250E+07	6.0800E-01	1.1500E+07	5.9300E-01	1.1750E+07	5.7600E-01
136	1.2000E+07	5.5800E-01	1.2250E+07	5.3800E-01	1.2500E+07	5.1800E-01	1.2750E+07	4.9800E-01	1.3000E+07	4.7500E-01
141	1.3250E+07	4.5000E-01	1.3500E+07	4.2500E-01	1.3750E+07	4.0500E-01	1.4000E+07	3.8200E-01	1.4250E+07	3.6500E-01
146	1.4500E+07	3.4700E-01	1.4750E+07	3.3200E-01	1.5000E+07	3.1600E-01	1.5250E+07	3.0200E-01	1.5500E+07	2.8800E-01
151	1.5750E+07	2.7600E-01	1.6000E+07	2.6400E-01	1.6250E+07	2.5300E-01	1.6500E+07	2.4300E-01	1.6750E+07	2.3400E-01
156	1.7000E+07	2.2700E-01	1.7250E+07	2.1950E-01	1.7500E+07	2.1250E-01	1.7750E+07	2.0700E-01	1.8000E+07	2.0240E-01
161	1.8250E+07	1.9780E-01	1.8500E+07	1.9500E-01	1.8750E+07	1.9250E-01	1.9000E+07	1.9100E-01	1.9250E+07	1.9000E-01
166	1.9500E+07	1.8900E-01	1.9750E+07	1.8900E-01	2.0000E+07	1.8900E-01				


NICKEL-58
(N,P)
NEUTRON CROSS SECTION
ENDF/B MAT NO. 6419
CROSS SECTION-BARNS (TIMES 10^1)
.00
1.00
2.00
3.00
4.00
5.00
6.00
ENERGY-EV (TIMES 10^7)
.20
.40
.60
.80
1.00
1.20
1.40
1.60
1.80

$^{60}Ni(n,p)^{60}Co$ Reaction for ENDF/B-IV*

M. R. Bhat

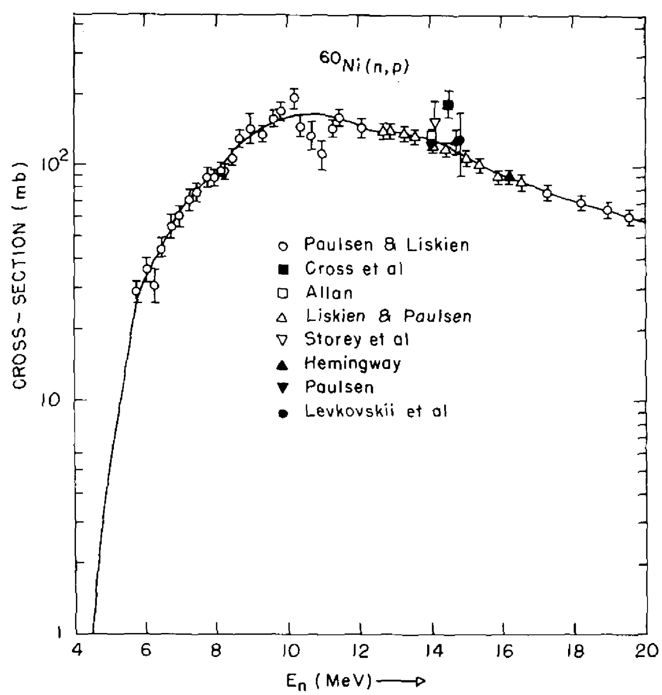
NNCSC

Brookhaven National Laboratory

The most extensive data on the $^{60}Ni(n,p)$ cross section from 5.76 to 19.55 MeV are by Paulsen and Liskien.[1-4] In these experiments the induced activity was measured by γ-γ coincidence counting and the efficiency of the coincidence spectrometer determined from calibrated radioactive sources whose activities were known to ±0.5%. The errors vary from 7-10% except for a few points where they are larger, up to 16%. The measurements of Cross et. al.[5] at 14.5, MeV when renormalized to an ^{27}Al (n,α) cross section of 118.6 mb (MAT = 1135 ENDF/B-III), give 186 mb and a later result[6] by the same authors is 165 mb; both appear to be too high compared to the Paulsen and Liskien data. Allan[7] determined the (n,p) cross section by measuring it at 120° to the neutron beam using photographic emulsion plates and multiplying by 4π the observed differential cross section. He obtained a value of 134 ± 9 mb at 14 MeV in good agreement with Liskien and Paulsen. How-

*Extracted from "Neutron and Gamma Ray Production Cross Sections for Nickel" BNL 50435 October 1974, M.R. Bhat.

evern, this technique has given results widely at variance with others. Storey et. al.[8] have determined the (n,p) cross section to be 158 ± 32 mb at 14.1 MeV which appears to be rather high compared to the general trend of the other data. Hemingway[9] obtained a cross section of 129 ± 16 mb at 14.7 ± 0.2 MeV using $^{56}Fe(n,p)\,^{56}Mn$ = 97.8 mb as a standard. This is to be compared with 104 mb recommended for the standard in the evaluation (MAT-6410) in ENDF/B-IV dosimetry files. This implies a 6% upward renormalization of the Hemingway value to give 137 mb. Levkovskii et. al.[10] have measured the (n,p) cross section to be 130 ± 40 mb which again is higher than the general trend of the Liskien - Paulsen data. The data not considered in this evaluation are by Preiss et. al.[11] (cross section to metastable state only) March et. al.[12] (too low) and Allan[13] (highly discrepant). In looking at all the available data it is unfortunate that there are no data from the threshold energy to 5.75 MeV, hence the rising part of the curve was drawn similar to the ^{58}Ni (n,p) cross section curve (after suitably shifting it for differences in the Q-values) and smoothly joined to a curve drawn through the experimental data at higher energies. The trend of the curve in this energy region is mainly determined by the Paulsen and Liskien data, as shown in Fig. 1.



60Ni(n,p)
CROSS - SECTION (mb)
10²
10
1
4
6
8
10
12
14
16
18
20
En (MeV)
Paulsen & Liskien
Cross et al
Allan
Liskien & Paulsen
Storey et al
Hemingway
Paulsen
Levkovskii et al

Figure 1

References

1. H. Liskien and A. Paulsen, Nucl. Phys. 63, 393 (1965).
2. H. Liskien and A. Paulsen, Nukleonik, 8, 315 (1966).
3. A. Paulsen, Nukleonik 10, 91 (1967).
4. A. Paulsen, Z. Physik 205, 226 (1967).
5. W. G. Cross, R. L. Clarke, K. Morin, G. Slinn, N. M. Ahmed and K. Beg, Bull. Amer. Phys. Soc. 7, 335 (1962).
6. W. G. Cross, R. L. Clarke, K. Morin, G. Slinn, N. M. Ahmed and K. Beg, EANDC (Can)-16 (1963).
7. D. L. Allan, Nucl. Phys. 24, 274 (1961).
8. R. S. Storey, W. Jack, and A. Ward, Proc. Phys. Soc. 75, 526, (1960).
9. J. D. Hemingway, Jour. Nucl. Energy 27, 241 (1973).
10. V. N. Levkovskii, G. P. Vinitskaya, G. E. Kovilskaya and V. M. Stepanov, Sovt. Jour. Nucl. Phys. 10, 25 (1969).
11. I. L. Preiss and R. W. Fink, Nucl. Phys. 15, 326 (1960).
12. P. V. March and W. T. Morton, Phil. Mag. 3, 577 (1958).
13. D. L. Allan, Proc. Phys. Soc. A70, 195 (1957)

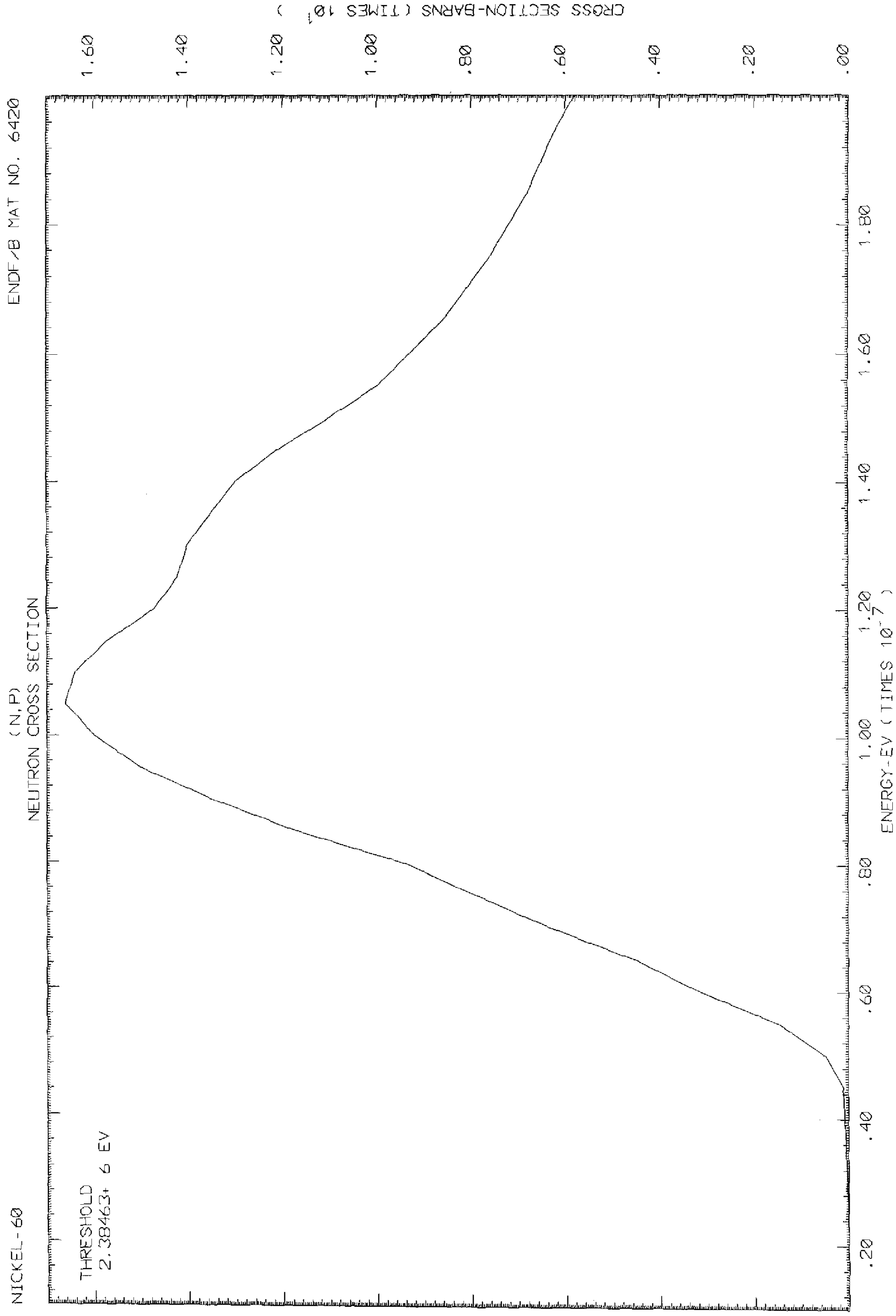
REACTION Q VALUE -2.0411E+06 EV

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION
1 TO 33	Y LINEAR IN X

NEUTRON CROSS SECTIONS

INDEX,	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	2.3846E+06	0.0000E+00	4.5000E+06	1.0000E-03	5.0000E+06	4.8000E-03	5.5000E+06	1.5000E-02	6.0000E+06	3.1500E-02
6	6.5000E+06	4.5000E-02	7.0000E+06	6.3000E-02	7.5000E+06	7.9000E-02	8.0000E+06	9.4000E-02	8.5000E+06	1.1700E-01
11	9.0000E+06	1.3500E-01	9.5000E+06	1.5000E-01	1.0000E+07	1.6000E-01	1.0500E+07	1.6600E-01	1.1000E+07	1.6400E-01
16	1.1500E+07	1.5700E-01	1.2000E+07	1.4700E-01	1.2500E+07	1.4200E-01	1.3000E+07	1.4000E-01	1.3500E+07	1.3500E-01
21	1.4000E+07	1.3000E-01	1.4500E+07	1.2100E-01	1.5000E+07	1.1000E-01	1.5500E+07	1.0000E-01	1.6000E+07	9.3000E-02
26	1.6500E+07	8.6000E-02	1.7000E+07	8.1000E-02	1.7500E+07	7.6000E-02	1.8000E+07	7.2000E-02	1.8500E+07	6.8000E-02
31	1.9000E+07	6.5000E-02	1.9500E+07	6.2000E-02	2.0000E+07	5.8000E-02				


NICKEL-60
(N,P)
NEUTRON CROSS SECTION
ENDF/B MAT NO. 6420
THRESHOLD
2.38463+ 6 EV
ENERGY-EV (TIMES 10^7)
CROSS SECTION-BARNS (TIMES 10)
.20
.40
.60
.80
1.00
1.20
1.40
1.60
1.80
.00
.20
.40
.60
.80
1.00
1.20
1.40
1.60

$^{63}Cu(n,\gamma)$; (n,α) Reactions for ENDF/B-IV

H. Alter*

Atomics International

March 1972

Introduction

Evaluated data sets for ^{63}Cu (n,γ) and (n,α) reactions contained in the ENDF/B-III and SAND files were reviewed, compared and where possible, intercompared with measured data. Specific sources were: for ENDF/B, Tape #303, MAT #1085, release date 1/21/72; for SAND, the National Neutron Cross Section Center at BNL provided the reviewer with data decks for the required neutron reactions. In addition, the NNCSC also provided a CSISRS listing of measured data for the two reactions in ^{63}Cu.

Review Procedure

All data sets were independently graphically displayed and respective data sets were then overlayed so that differences could be visually interpreted (e.g., Fig. 1-3 the (n,γ) cross sections).

(n,γ) Cross Section

Below 1 eV the data from the ENDF/B and SAND libraries are essentially identical. Above 1 eV the data sets diverge with the SAND data being lower in magnitude. The ENDF/B data in the resolved resonance region is more highly resolved than that in the

* Present Address: U. S. Energy Research Development Administration, Washington, D.C. 20045.

SAND library. To further analyze the data in the energy region 10 eV to 30 keV, both sets of data were group averaged (group width equal to 0.5 lethargy units) weighting with a 1/E spectrum. Results are given in Table 1. The group constants based on the ENDF/B parameters were obtained analytically using the File 2 resonance parameters. The SAND data did not have parameters, therefore the related group constants were obtained by numerical

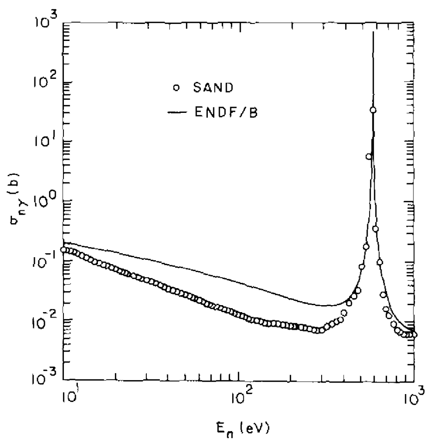


Figure 1

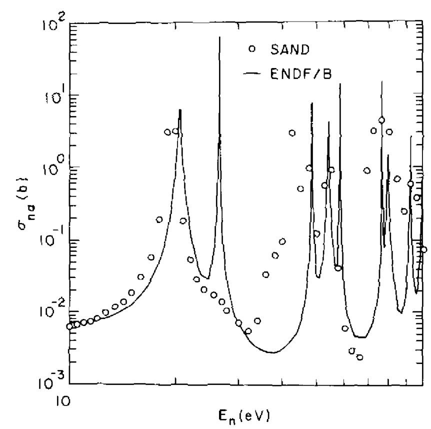


Figure 2

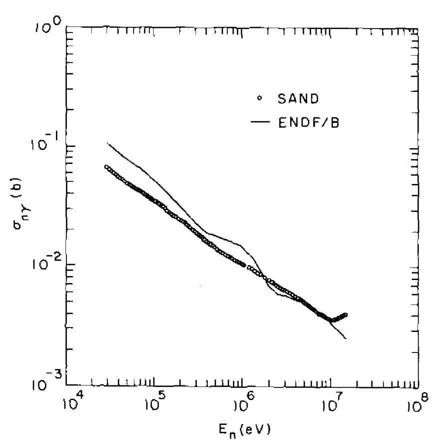


Figure 3

integration. To be assured that this comparison was valid, the ENDF/B resonance parameters were used to generate the (n,γ) line shape and these data were then numerically integrated.

Agreement between the analytic calculation and the numerical integration is generally quite good except at the first few resonance peaks. The differences in group constants (ENDF/B vs SAND) are apparent and can easily be related back to the energy dependent cross section data.

In Table 2 calculated resonance integrals for ^{63}Cu (n,γ) are compared with a number of reported measurements. In a recent compilation of resonance integrals, M.K. Drake* gives for ^{63}Cu a value of 5.1 ± 0.2b. A recent compilation of values for resonance integral cross sections, given in "Neutron Fluence Measurements", Technical Report Series #107, IAEA, Vienna 1970, range from 4.2 to 5.1 barns. These values are given for various cutoff energies. Generally the reported data agree reasonably well with ENDF/B-III.

Above 30 keV experimental data, supplied by the NNCSC, are plotted on the overlay ENDF/B and SAND cross section curves (e.g. Fig. 4-5). Resolution of the discrepant data in this energy region requires a more extensive effort than that currently applied for this task force review. One notes however, that the magnitude of the cross section in this region is generally less than 120 mb.

Based on this review, MAT #1085 (ENDF/B-III) is accepted to 30 keV and above 1.8 MeV. Between 30 keV and 1.8 MeV, at least squares fit of the data in (Fig. 4-5) is utilized, and

* Private communication, M.K. Drake to E. Ottewitte, 1970.

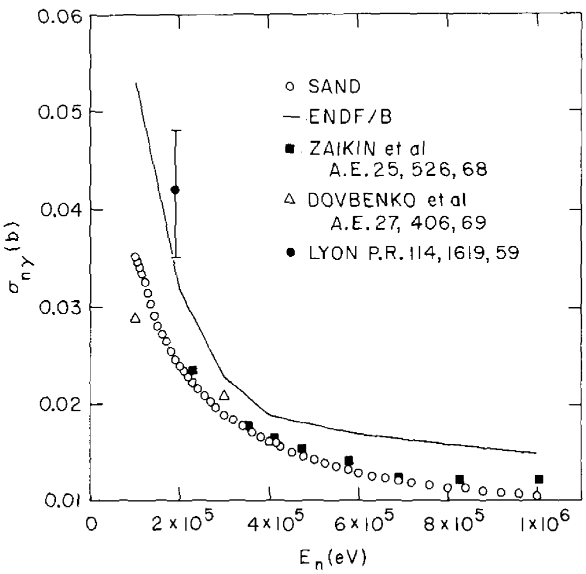


Figure 4

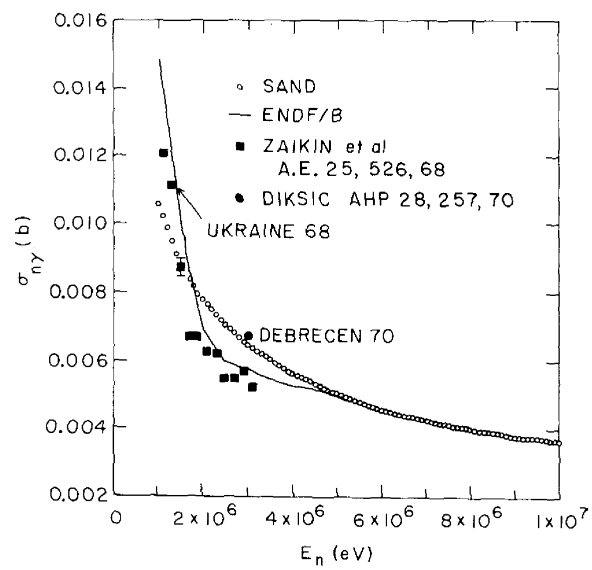


Figure 5

joined to MAT #1085* (insufficient data does not permit high confidence in the evaluation above 30 keV).

(n,α) Cross Section

The SAND file (n,α) cross section data were obtained from the NNCSC, and overlayed with the ENDF/B data for energies greater than ∿5.5 MeV. The SAND (n,α) data extends from .0001 eV to ∿18 MeV.

In Fig. 6, experimental values of the (n,α) cross section supplied by the NNCSC and also obtained from a brief review of the literature are plotted against the overlay ENDF/B and SAND curves. Generally, the measured values fall between the two evaluated curves.

In Table 3, calculated values for the fission spectrum averaged (n,α) reaction are given. Results are given for both the Cranberg and Watt representations of the fission spectrum.

In Table 4, both measured and calculated values of this quantity are given. These values are all within a factor of ∿2 of each other.

* Data extrapolated from 15-20 Mev at NNCSC January 1974.

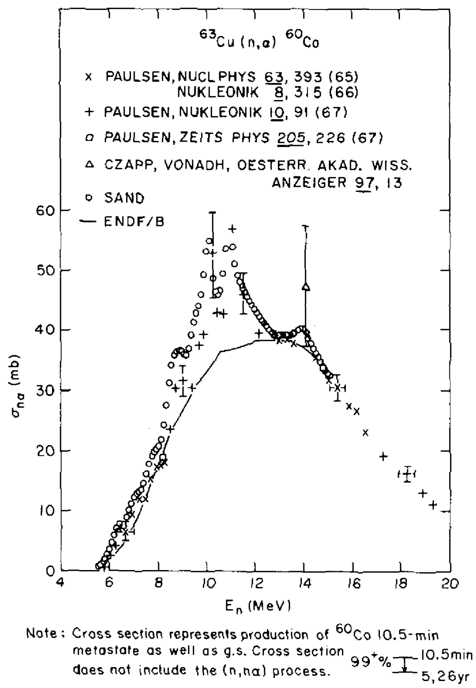


Figure 6

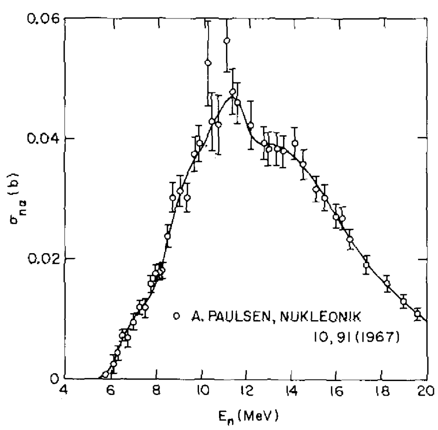


Figure 7

Paulsen (Nukleonik 10, 91) quotes a value of 0.34 ± 0.04 for the (n,α) reaction integrated over a Watt spectrum. Taking measured differential cross sections, (eliminating the data points at 10.17 and 10.98 MeV as he suggested) and calculating the fission spectrum average using the Watt representation the following results are obtained:

ΔE	$\bar{\sigma}$(mb)
5.5 - 15.0 MeV	0.343
5.5 - 19.55 MeV	0.344

This result, when compared to the calculated quantities in Table 3, falls between the ENDF/B value 0.298 and the SAND value 0.442.

From the review of the ^{63}Cu (n,α) reaction one concludes that neither of the evaluated sets is adequate. The spectrum averaged quantity using the ENDF/B data is consistently lower than the same quantity using the SAND data. This is consistent with the respective sets of evaluated data. The value of 0.356 mb quoted in BNWL-1312 does not appear to be consistent with the same spectrum averaged quantity, 0.490 mb, calculated for this review. The reason for this discrepancy is not known at this time. Therefore, for ENDF/B-IV the Paulsen data, (Nukleonik, 8, 315 (1966); 10, 91 (1967), and Nucl. Phy. 63, 393 (1965) with the points 10.17 and 10.98 omitted, are to be adopted.

Table 1

Comparison of ENDF/B-III and SAND ^{63}Cu Capture Cross Section for

10 eV $\leq$ E $\leq$ 25 KeV

Group Boundary E_L (Δ u = 0.5)	ENDF/B (Barns) (Analytic Solution)	ENDF/B (Barns) (Numerical Integration)	SAND (Barns) (Numerical Integration)
24.788 kev			
15.034	0.109	0.110	0.081
9.1188	0.192	0.193	0.152
5.5308	0.243	0.246	1.265
3.3546	0.226	0.228	0.626
2.0347	0.721	0.730	0.096
1.2341	0.143	0.145	0.592
748.52 eV	0.046	0.046	0.007
454.	5.337	5.400	3.438
275.36	0.046	0.046	0.013
167.02	0.043	0.043	0.009
101.30	0.053	0.052	0.011
61.442	0.067	0.067	0.018
37.267	0.090	0.090	0.030
22.603	0.121	0.121	0.051
13.710	0.162	0.161	0.088

Table 2

Comparison of Calculated and

Measured Resonance Integrals for $^{63}Cu(n,\gamma)$

(Calculated: E_c = 0.5 ev)

ENDF/B	SAND	BNWL-1312
(BARNS)		
5.35	4.79	4.64

(MEASURED)

Measured Value (b)	Cutoff Energy, E_c (ev)	Remarks	I_∞, Adjusted to E=0.5 ev Including 1/v(b)	Ref.
4.4	0.52	1/v included	4.4	1
3.09±0.15	0.5	No 1/v, restored using σ_{a2200}=4.5 b	5.11±0.2	2
3.17±0.18	0.62	No 1/v, restored using σ_{a2200}=4.5 b	4.99±0.2	3
4.2±0.2	0.62	5 mil foil	5.3±0.2	4

1. R. Macklin and H. Pomerance, 5, 96 (1955).

2. R. Dahlberg, K. Jirlow and E. Johansson, J. Nucl. Energy AB, 14, 53 (1961).

3. N.P. Baumann, DP 817 (1963).

4. L. Anderson, Health Physics, 10, 315 (1964).

Table 3

Comparison of Calculated Values

for the Fission Spectrum Averaged

^{63}Cu (n,α) Reaction

(MILLIBARNS)

DATA	SPECTRUM	ENERGY INTERVAL	RESULT
ENDF/B	CRANBERG	5.5 - 15.0 MeV	0.274
ENDF/B	WATT	5.5 - 15.0 MeV	0.298
SAND	CRANBERG	5.5 - 15.0 MeV	0.408
SAND	WATT	5.5 - 15.0 MeV	0.442
SAND	CRANBERG	10^{-9} - 15 MeV	0.455
SAND	WATT	10^{-9} - 15 MeV	0.490
BNWL-1312	WATT	10^{-10}-18 MeV	0.356

CRANBERG: $f(E) = 0.453 \exp(-E/0.965) \sinh(2.29\ E)^{1/2}$

WATT: $f(E) = 0.484 \exp(-E) \sinh(2E)^{1/2}$

Table 4

Values of the Fission Spectrum Averaged ^{63}Cu (n,α) Reaction

Fission-Spectrum Averaged XSC (mb)	Basis	Reference	Year
.76	Empirical estimate	Roy, Hawton CRC-1003	1962
.72	Measurement relative to 0.60 mb for ^{27}Al (n,α) ^{24}Na	R.S. Rochlin, Nucleonics 17, 54	1959
.54±.07	Measurement relative to 101 mb for ^{58}Ni (n,p) ^{58}Co	R. Nilssm, Neutron Dosimetry, VII, 275	1963
.42	Measurement relative to 0.57 mb for ^{27}Al (n,α) ^{24}Na	C.H. Hogg, L.D. Weber Symposium on Rad. Eff. on Metals and Neut. Dos., 133 (ASTM)	1963
.36±.04	Measurement relative to 65 mb for ^{32}S (n,p) ^{32}P	R.L. Ritzman, et al. Ibid, 141	1963
.45±.05	Measurement relative to 76 mb for ^{54}Fe (n,p) ^{54}Mn	D.M. Clare, W.H. Martin J. Nucl. En. 18, 703	1964
.52±.04	Measurement relative to (1) 63 mb for ^{32}S (n,p) ^{32}P (2) 0.63 mb for ^{27}Al (n,α) ^{56}Mn (3) 1.04 mb for ^{56}Fe (n,p)	A. Fabry EANDC (E) 66U	1965
.44	Measurement relative to 90.6 mb for ^{58}Ni (n,p) ^{58}Co	(Grenoble) EANDC (E) 57U	1965
.382	Integration of an evaluated curve	Sov. J. At. E. 25, 1251	1968
.34±.04	Integration of an evaluated curve (over Watt spectrum)	Paulsen, Nukleonik 10, 91	1967
.356	Integration of evaluated curve (over Watt spectrum)	BNWL-1312	1970

ISOTOPE------------------------COPPER-63
FRACTIONAL ABUNDANCE---------- 1.0000E+00
NUMBER OF ENERGY RANGES------ 1

ENERGY RANGE NUMBER---------- 1 RESOLVED MULTILEVEL BREIT-WIGNER PARAMETERS
LOWER ENERGY LIMIT (EV)------ 1.0000E+01
UPPER ENERGY LIMIT (EV)------ 3.0000E+04
NUCLEAR SPIN----------------- 1.5000E+00
SPIN SCATTERING LENGTH (A+)-- 7.3020E-01
NUMBER OF L STATES----------- 1

L VALUE---------------------- 0
NUMBER OF RESONANCES--------- 28
SPIN SCATTERING LENGTH (A-)-- 0.0000E+00

			RESONANCE WIDTHS (EV)			
INDEX	ENERGY (EV)	J VALUE	TOTAL	NEUTRON	RADIATION	FISSION
1	-3.0690E+02	2.0000E+00	5.1030E+00	4.5530E+00	5.5000E-01	0.0000E+00
2	5.7770E+02	2.0000E+00	1.4100E+00	8.6000E-01	5.5000E-01	0.0000E+00
3	2.0600E+03	1.0000E+00	4.4050E+01	4.3500E+01	5.5000E-01	0.0000E+00
4	2.6600E+03	2.0000E+00	5.0500E+00	4.5000E+00	5.5000E-01	0.0000E+00
5	4.8600E+03	1.0000E+00	1.4550E+01	1.4000E+01	5.5000E-01	0.0000E+00
6	5.3900E+03	2.0000E+00	4.0550E+01	4.0000E+01	5.5000E-01	0.0000E+00
7	5.8200E+03	2.0000E+00	1.0950E+01	1.0400E+01	5.5000E-01	0.0000E+00
8	7.6400E+03	2.0000E+00	7.3500E+00	6.8000E+00	5.5000E-01	0.0000E+00
9	7.9400E+03	2.0000E+00	8.0550E+01	8.0000E+01	5.5000E-01	0.0000E+00
10	9.2000E+03	2.0000E+00	3.7150E+01	3.6600E+01	5.5000E-01	0.0000E+00
11	9.9300E+03	1.0000E+00	8.7550E+01	8.7000E+01	5.5000E-01	0.0000E+00
12	1.0850E+04	2.0000E+00	5.8550E+01	5.8000E+01	5.5000E-01	0.0000E+00
13	1.2540E+04	1.0000E+00	2.3550E+01	2.3000E+01	5.5000E-01	0.0000E+00
14	1.3170E+04	2.0000E+00	6.6550E+01	6.6000E+01	5.5000E-01	0.0000E+00
15	1.3700E+04	2.0000E+00	3.9990E+01	3.9440E+01	5.5000E-01	0.0000E+00
16	1.4900E+04	2.0000E+00	2.8310E+01	2.7760E+01	5.5000E-01	0.0000E+00
17	1.5600E+04	2.0000E+00	1.8230E+01	1.7680E+01	5.5000E-01	0.0000E+00
18	1.6100E+04	2.0000E+00	1.1590E+01	1.1040E+01	5.5000E-01	0.0000E+00
19	1.7880E+04	1.0000E+00	1.3355E+02	1.3300E+02	5.5000E-01	0.0000E+00
20	1.8120E+04	1.0000E+00	1.3355E+02	1.3300E+02	5.5000E-01	0.0000E+00
21	2.1040E+04	1.0000E+00	2.0055E+02	2.0000E+02	5.5000E-01	0.0000E+00
22	2.1250E+04	2.0000E+00	1.2055E+02	1.2000E+02	5.5000E-01	0.0000E+00
23	2.2820E+04	2.0000E+00	1.1255E+02	1.1200E+02	5.5000E-01	0.0000E+00
24	2.4800E+04	2.0000E+00	6.0950E+01	6.0400E+01	5.5000E-01	0.0000E+00
25	2.5600E+04	2.0000E+00	1.6615E+02	1.6560E+02	5.5000E-01	0.0000E+00
26	2.6500E+04	2.0000E+00	9.7350E+01	9.6800E+01	5.5000E-01	0.0000E+00
27	2.8200E+04	1.0000E+00	6.9210E+01	6.8660E+01	5.5000E-01	0.0000E+00
28	2.9300E+04	1.0000E+00	3.2285E+02	3.2230E+02	5.5000E-01	0.0000E+00

COPPER-63 (N,GAMMA) NEUTRON CROSS SECTION ENDF/B MATERIAL NO. 6411

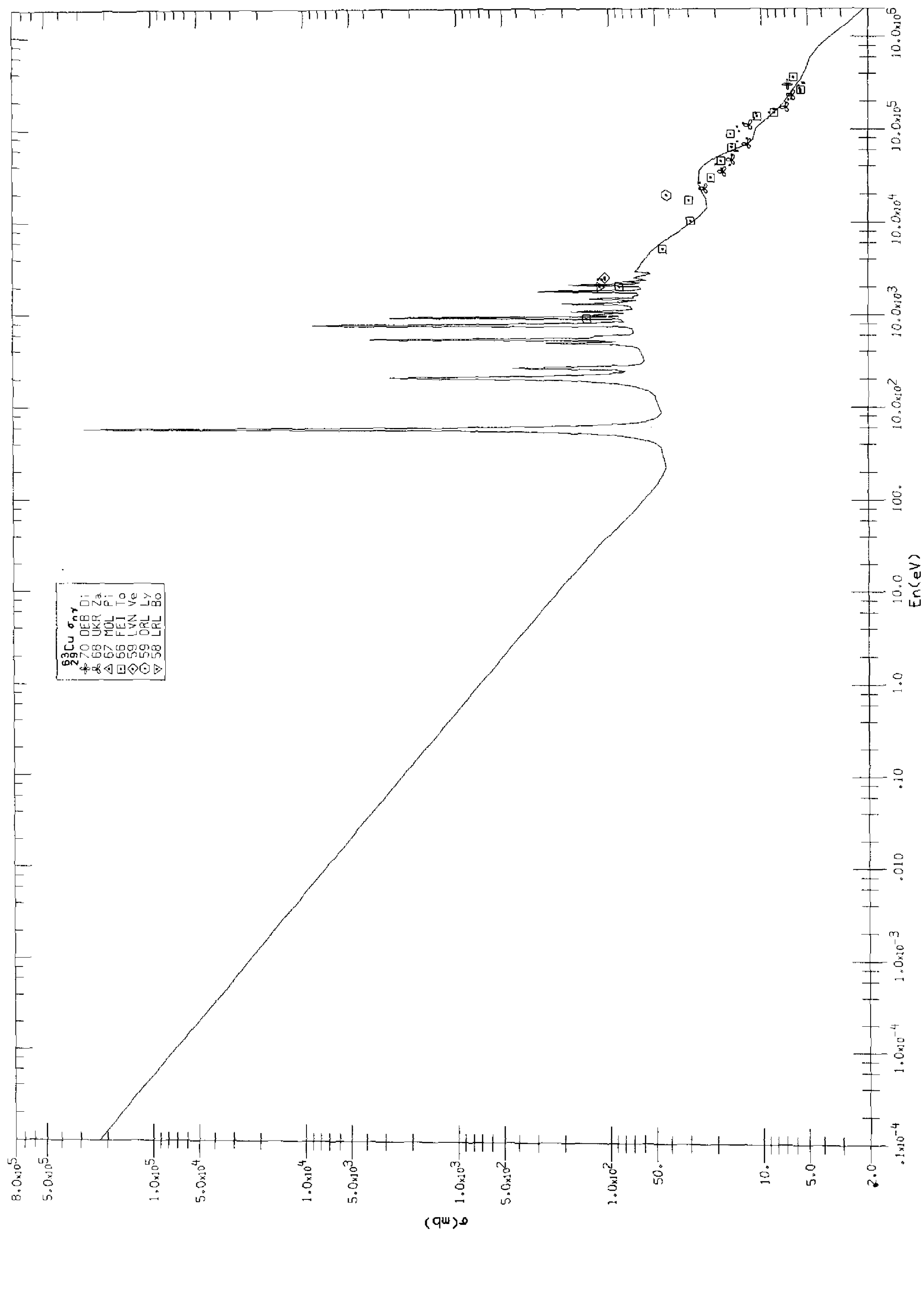
REACTION Q VALUE 7.9159E+06 EV

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION
1 TO 124	LN Y LINEAR IN LN X

NEUTRON CROSS SECTIONS

INDEX,	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	1.0000E-05	2.2626E+02	1.0000E-04	7.1500E+01	5.0000E-04	3.1900E+01	1.0000E-03	2.2626E+01	2.5300E-02	4.4977E+00
6	5.1262E-01	9.9640E-01	1.0000E+00	7.1150E-01	5.5000E+00	2.9590E-01	1.0000E+01	2.1410E-01	1.0000E+01	4.0000E-03
11	5.0000E+01	9.0000E-03	1.0000E+02	1.3000E-02	5.0000E+02	2.9000E-02	1.0000E+03	3.8000E-02	5.0000E+03	6.2000E-02
16	1.0000E+04	6.6000E-02	2.0000E+04	5.8000E-02	3.0000E+04	4.8000E-02	3.0000E+04	6.5000E-02	3.2000E+04	6.3626E-02
21	3.4000E+04	6.2148E-02	3.6000E+04	6.0754E-02	3.8000E+04	5.9435E-02	4.0000E+04	5.7943E-02	4.2500E+04	5.6180E-02
26	4.5000E+04	5.4518E-02	4.7500E+04	5.2786E-02	5.0000E+04	5.1143E-02	5.2500E+04	4.9484E-02	5.5000E+04	4.7902E-02
31	5.7500E+04	4.6391E-02	6.0000E+04	4.4909E-02	6.3000E+04	4.3210E-02	6.6000E+04	4.1606E-02	6.9000E+04	4.0074E-02
36	7.2000E+04	3.8607E-02	7.6000E+04	3.6811E-02	8.0000E+04	3.5107E-02	8.4000E+04	3.3581E-02	8.8000E+04	3.2125E-02
41	9.2000E+04	3.0848E-02	9.6000E+04	2.9625E-02	1.0000E+05	2.8627E-02	1.0500E+05	2.7434E-02	1.1000E+05	2.6296E-02
46	1.1500E+05	2.5451E-02	1.2000E+05	2.4642E-02	1.2750E+05	2.3955E-02	1.3500E+05	2.3307E-02	1.4250E+05	2.2727E-02
51	1.5000E+05	2.2630E-02	1.6000E+05	2.2508E-02	1.7000E+05	2.2888E-02	1.8000E+05	2.3247E-02	1.9000E+05	2.3586E-02
56	2.0000E+05	2.4059E-02	2.1000E+05	2.4508E-02	2.2000E+05	2.4649E-02	2.3000E+05	2.5176E-02	2.4000E+05	2.5488E-02
61	2.5500E+05	2.5755E-02	2.7000E+05	2.6007E-02	2.8000E+05	2.6001E-02	3.0000E+05	2.5990E-02	3.2000E+05	2.5979E-02
66	3.4000E+05	2.5621E-02	3.6000E+05	2.5284E-02	3.8000E+05	2.4620E-02	4.0000E+05	2.3991E-02	4.2500E+05	2.3167E-02
71	4.5000E+05	2.2082E-02	4.7500E+05	2.1086E-02	5.0000E+05	1.9813E-02	5.2500E+05	1.8631E-02	5.5000E+05	1.7504E-02
76	5.7500E+05	1.6347E-02	6.0000E+05	1.5240E-02	6.3000E+05	1.4093E-02	6.6000E+05	1.3000E-02	6.9000E+05	1.2442E-02
81	7.2000E+05	1.1908E-02	7.6000E+05	1.1229E-02	8.0000E+05	1.1208E-02	8.4000E+05	1.1189E-02	8.8000E+05	1.1170E-02
86	9.2000E+05	1.1122E-02	9.6000E+05	1.1075E-02	1.0000E+06	1.0831E-02	1.1000E+06	1.0263E-02	1.2000E+06	9.7433E-03
91	1.3000E+06	9.1894E-03	1.4000E+06	8.6766E-03	1.5000E+06	8.3068E-03	1.6000E+06	7.9609E-03	1.7000E+06	7.6360E-03
96	1.8000E+06	7.4123E-03	2.0000E+06	7.0000E-03	2.5000E+06	6.3626E-03	3.0000E+06	5.8417E-03	3.5000E+06	5.4014E-03
101	4.0000E+06	5.2349E-03	4.5000E+06	5.0881E-03	5.0000E+06	4.9730E-03	5.5000E+06	4.8689E-03	6.0000E+06	4.7738E-03
106	6.5000E+06	4.6222E-03	7.0000E+06	4.4819E-03	7.5000E+06	4.3064E-03	8.0000E+06	4.1423E-03	8.5000E+06	3.9881E-03
111	9.0000E+06	3.8229E-03	9.5000E+06	3.6667E-03	1.0000E+07	3.5268E-03	1.0500E+07	3.3936E-03	1.1000E+07	3.2667E-03
116	1.1500E+07	3.1609E-03	1.2000E+07	3.0596E-03	1.2500E+07	2.9732E-03	1.3000E+07	2.8902E-03	1.3500E+07	2.8103E-03
121	1.4000E+07	2.7377E-03	1.4500E+07	2.6677E-03	1.5000E+07	2.6000E-03	2.0000E+07	2.1000E-03		



$^{63}_{29}Cu$ $\sigma_{n\gamma}$
70 DEB Di
68 UKR Za
67 MOL Pi
66 FEI To
59 LVN Ve
59 ORL Ly
58 LRL Bo
En(eV)
σ(mb)
$8.0x10^5$
$5.0x10^5$
$1.0x10^5$
$5.0x10^4$
$1.0x10^4$
$5.0x10^3$
$1.0x10^3$
$5.0x10^2$
$1.0x10^2$
50.
10.
5.0
2.0
$.1x10^{-4}$
$1.0x10^{-4}$
$1.0x10^{-3}$
.010
.10
1.0
10.0
100.
$10.0x10^2$
$10.0x10^3$
$10.0x10^4$
$10.0x10^5$
$10.0x10^6$

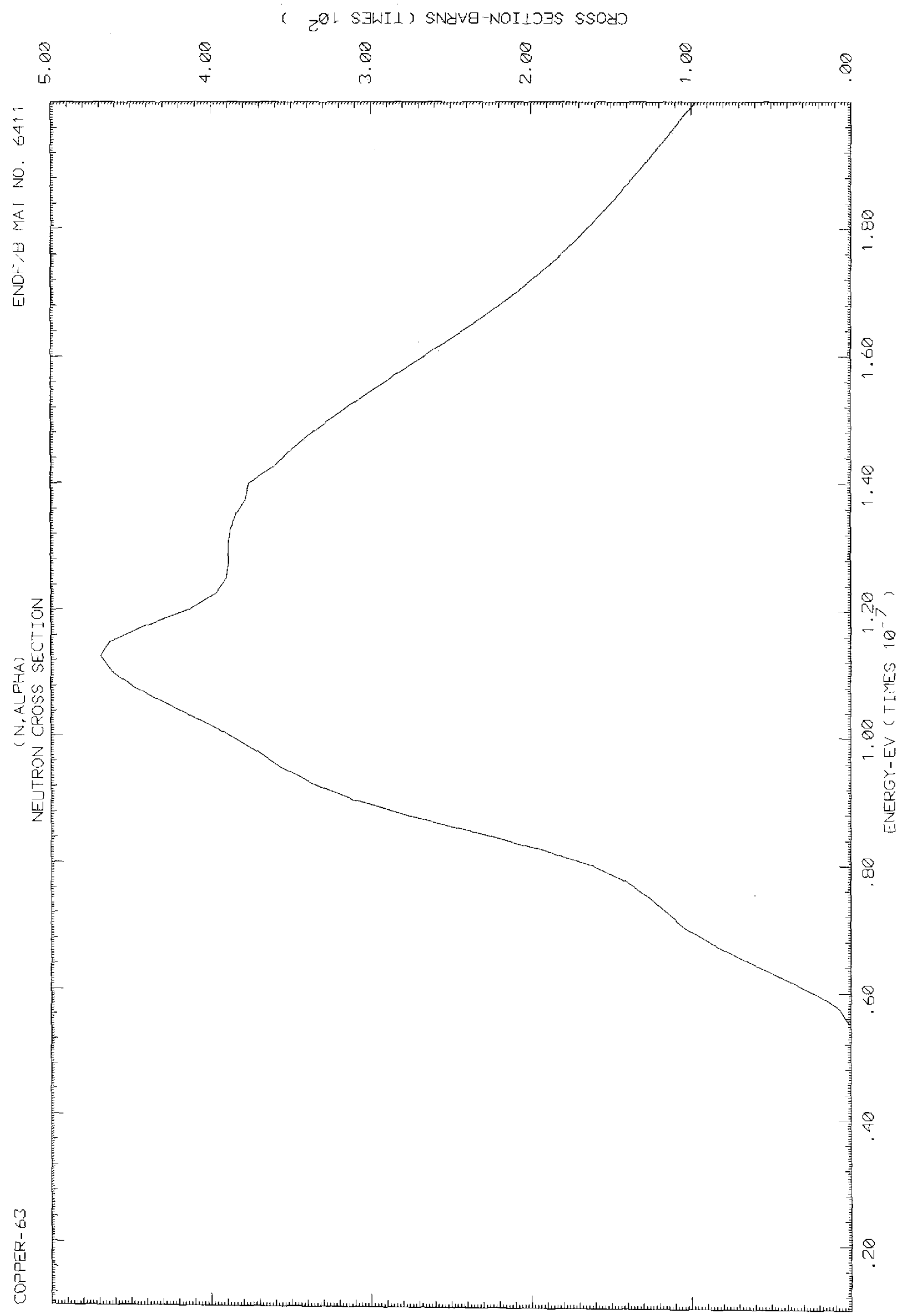
REACTION Q VALUE 1.7149E+06 EV

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION
1 TO 59	Y LINEAR IN X

NEUTRON CROSS SECTIONS

INDEX,	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	5.5000E+06	1.0000E-04	5.7500E+06	6.9880E-04	6.0000E+06	2.3600E-03	6.2500E+06	4.4200E-03	6.5000E+06	6.5750E-03
6	6.7500E+06	8.6060E-03	7.0000E+06	1.0296E-02	7.2500E+06	1.1537E-02	7.5000E+06	1.2661E-02	7.7500E+06	1.4110E-02
11	8.0000E+06	1.6326E-02	8.2500E+06	1.9585E-02	8.5000E+06	2.3490E-02	8.7500E+06	2.7480E-02	9.0000E+06	3.0992E-02
16	9.2500E+06	3.3616E-02	9.5000E+06	3.5553E-02	9.7500E+06	3.7155E-02	1.0000E+07	3.8776E-02	1.0250E+07	4.0667E-02
21	1.0500E+07	4.2681E-02	1.0750E+07	4.4567E-02	1.1000E+07	4.6077E-02	1.1250E+07	4.6877E-02	1.1500E+07	4.6302E-02
26	1.1750E+07	4.4016E-02	1.2000E+07	4.1352E-02	1.2250E+07	3.9696E-02	1.2500E+07	3.9005E-02	1.2750E+07	3.8876E-02
31	1.3000E+07	3.8906E-02	1.3250E+07	3.8763E-02	1.3500E+07	3.8395E-02	1.3750E+07	3.7822E-02	1.4000E+07	3.7604E-02
36	1.4250E+07	3.6139E-02	1.4500E+07	3.5067E-02	1.4750E+07	3.3867E-02	1.5000E+07	3.2559E-02	1.5250E+07	3.1163E-02
41	1.5500E+07	2.9702E-02	1.5750E+07	2.8200E-02	1.6000E+07	2.6682E-02	1.6250E+07	2.5171E-02	1.6500E+07	2.3692E-02
46	1.6750E+07	2.2269E-02	1.7000E+07	2.0926E-02	1.7250E+07	1.9682E-02	1.7500E+07	1.8531E-02	1.7750E+07	1.7463E-02
51	1.8000E+07	1.6465E-02	1.8250E+07	1.5528E-02	1.8500E+07	1.4640E-02	1.8750E+07	1.3789E-02	1.9000E+07	1.2966E-02
56	1.9250E+07	1.2158E-02	1.9500E+07	1.1356E-02	1.9750E+07	1.0547E-02	2.0000E+07	9.7202E-03		


COPPER-63
(N,ALPHA)
NEUTRON CROSS SECTION
ENDF/B MAT NO. 6411
CROSS SECTION-BARNS (TIMES 10^2)
5.00
4.00
3.00
2.00
1.00
.00
ENERGY-EV (TIMES 10^7)
.20
.40
.60
.80
1.00
1.20
1.40
1.60
1.80

REFERENCES FOR EXPERIMENTAL DATA

$^{63}Cu(n,\gamma)$

Yr.	Lab	Author	References
70	DEB	Diksic, et al.	Acta Phys. Hun. 28, 257 (1970)
69	FEI	Dovbenko, et al.	INDC 260, 11 (1969)
68	MUA	Hasan, et al.	Nuov. Cim./B 58, 402 (1968)
68	UKR	Zaikin, et al.	At. En. 25, 526 (1968)
67	MOL	Pinancelli, et al.	EANDC-(E)-76, 1 (1967)
66	FEI	Tolstikov, et al.	At. En. 21, 1 (1966)
59	LVN	Vervier	Nuc. Phys. 9, 569 (1959)
59	ORL	Lyon, et al.	Phys. Rev. 114, 1619 (1959)
58	LRL	Booth, et al.	Phys. Rev. 112, 226 (1958)
57	ORL	Macklin, et al.	Phys. Rev. 107, 504 (1957)

The $^{65}Cu(n,2n)\,^{64}Cu$ Reaction for ENDF/B-IV

P. F. Rose *

Atomics International

May 3, 1972

I Introduction

The $^{65}Cu(n,2n)^{64}Cu$ reaction has been re-evaluated for the ENDF/B-files using a combination of selected experimental data and a semi-empirical technique for fitting the data at energies above 15 MeV. An estimate of the (n,3n) reaction was also obtained as a result of the analysis.

II Theory

The theoretical approach of S. Pearlstein[1] was utilized. Pearlstein's estimate of the (n,2n) cross-section was based upon the expression

$$\sigma_{n,2n} = \sigma_{ne} \times \frac{\sigma n,M}{\sigma ne} \times \frac{\sigma n,2n}{\sigma n,M} \qquad (1)$$

where σ_{ne} is the non-elastic cross-section and $\sigma_{n,M}$ is the sum of the neutron emission cross-sections. Pearlstein obtained the ratio $\sigma_{n,M}/\,\sigma_{ne}$ as an empirical fit to nuclear data.

Pearlstein obtained the energy dependent ratio $\sigma_{n,2n}/\,\sigma_{n,M}$ from statistical compound nucleus theory. His final working equation is:

*Presently at Brookhaven National Laboratory.

$$\frac{\sigma_{n,2n}}{} = 1 - \frac{e^{p^{1/2}}\left[(1-\frac{1}{s})p\frac{3}{2}-(3-\frac{1}{s})p+6p^{1/2}-6\right]+6-\frac{p}{s}}{e^{\left(\frac{p}{s}\right)^{1/2}}\left[-2\ (\frac{p}{s})+6(\frac{p}{s})^{1/2}-6\right]+6-\frac{p}{s}} \qquad (2)$$

in which $p = 4a\ S_n$, $S=S_n/E_n$, and a is the familar level density parameter of the residual nucleus (Z,N). If the threshold for the occurrence of the (n,3n) reaction is overlapped by the neutron energies, the (n,3n) cross-section is calculated with $p=4aS_{2n}$ and $S=S_{2n}/E_n$. For this case the cross-section using S_n is for the sum of the (n,2n) and (n,3n) cross-sections. Equation 2 was used for the evaluation of the $^{65}Cu(n,2n)\ ^{64}Cu$ reaction at energies above 15 MeV.

III Experimental

In evaluating the $^{65}Cu(n,2n)^{64}Cu$ reaction four sets of data, representing the major amount of experimental information, were selected for the analysis. Individual experimental points (notably around 14 Mev) were not included in the analysis and, where measurements were repeated, the latest experiment was used.

The oldest experiment used were that of R. J. Prestwood and B. P. Bayhurst(2). The data was partly normalized relative to the fission cross-section of U^{238} (3 highest energies, Circa 1961). The lower energy points, however, were obtained absolutely. The errors quoted in the article are inferred from theoretical considerations and are not experimental errors.

A. Paulsen and H. Liskien(3) measured an absolute excitation function between 12.6 and 19.6 Mev. The measurement (1965) is based upon a neutron flux determination by detection of recoil protons. The quoted uncertainty is ± 8% with energy uncertainties between ± 0.11 to 0.47 Mev.

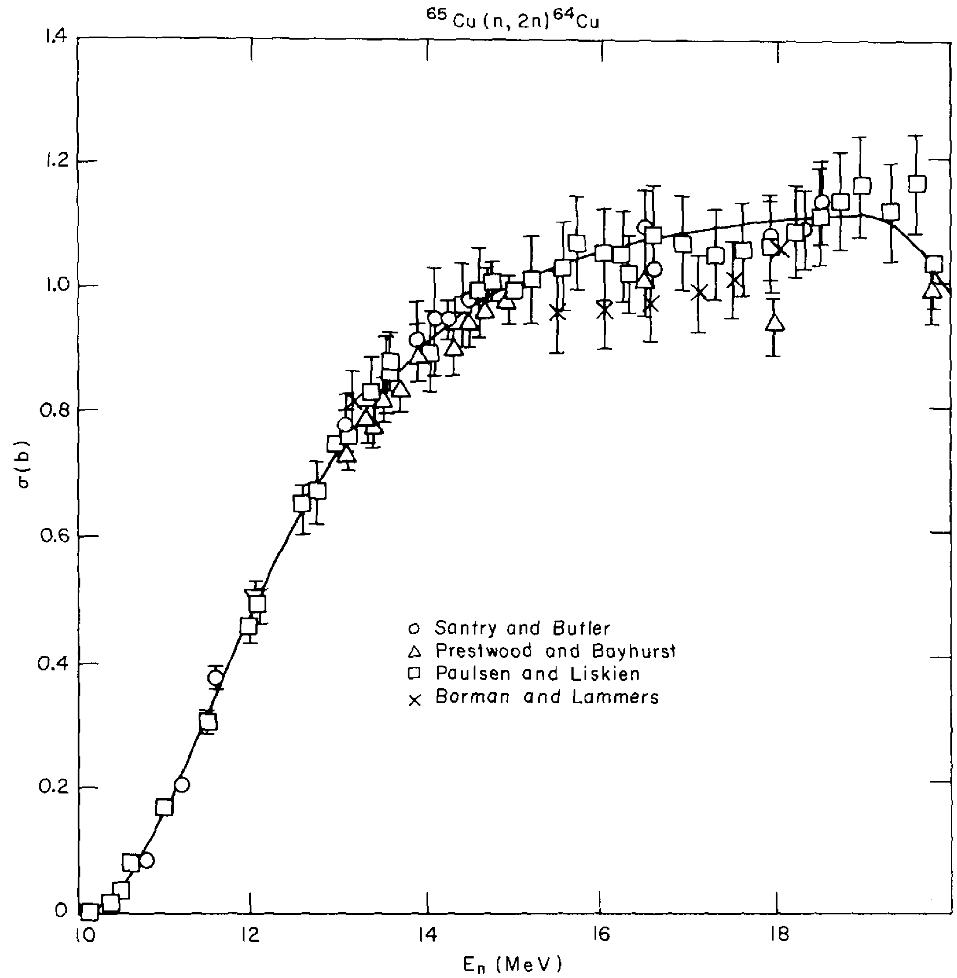
In 1966, D. C. Santry and J. P. Butler[(4)] presented data for a complete excitation function between 10 and 20 Mev. This was measured by activation relative to the $S^{32}(n,p)P^{32}$ cross-section. The uncertainty of the sulphur cross-section and angular neutron intensity are included in the quoted uncertainty of ± 8%. Santry and Butler quote a fission average (n,2n) cross-section of 0.251 ± 0.018 mb.

A series of measurements have been reported by M. Bormann and co-authors. Bormann's 1963 data[(5)] shows prominent (n,3n) competition. M. Bormann and B. Lammers [(6)] have re-measured the (n,2n) cross-section (1969). This latter measurement is in agreement with the other experiments, and does not show the prominent reduction of cross-section near 20 Mev which the earlier measurement indicates. The earlier data was not used in the present evaluation.

IV Results

Fig. 1 shows the experimental data and the evaluated curve. The evaluated curve was obtained from a least squares spline fit of the experimental data below 15 Mev, and by a parametric fit of the data above 15 Mev using the formalulism of equation [(2)].

An effective value of S_{2n} was introduced in order to adequately fit the experimental data at the higher energies. An



$^{65}Cu(n,2n)^{64}Cu$
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
σ (b)
10
12
14
16
18
E_n (MeV)
○ Santry and Butler
△ Prestwood and Bayhurst
□ Paulsen and Liskien
× Borman and Lammers

Figure 1

upward shift of the (n,3n) reaction threshold is supported by Lu[7] and has been discussed in an article by Hankla and Fink[8]. Table 1 summarizes the parameters used to obtain the evaluated curve.

Table 1 Parameters for ^{65}Cu (n,2n) ^{64}Cu Reaction

Parameter	Value
$\sigma_{n,m}$	1.081 barns
a	6.0 MeV^{-1}
S_n	10.1 MeV
S_{2n}	18.1 MeV
S_{2n} effective	k9.0 Mev

Values for the (n,3n) reaction were also obtained from the theoretical fit as described in Section II.

References

1. S. Pearlstein, "Analysis of (n,2n) Cross-Sections for Nuclei of Mass A>30", BNL 897 (T-365), EANDC (US)-71, Brookhaven National Laboratory, (1964).
2. R. J. Prestwood and B. P. Bayhurst, Phys. Rev. 121, 1438 (1961).
3. A. Paulsen and H. Liskien, Nukleonik 7, 117 (1965).
4. D. C. Santry and J. P. Butler, Can. J. Phys. 44, 1183 (1966).
5. M. Bormann, et. al. Zeitschrift fur Physik, 174, 1, (1963).
6. M. Bormann and B. Lammers, Nucl. Phys. A130, 195 (1969).
7. W. Lu and R. W. Fink, Phys. Rev. C4, 1173 (1971).
8. A. K. Hankla and R. W. Fink, Nucl. Phys. A180, 157 (1971).

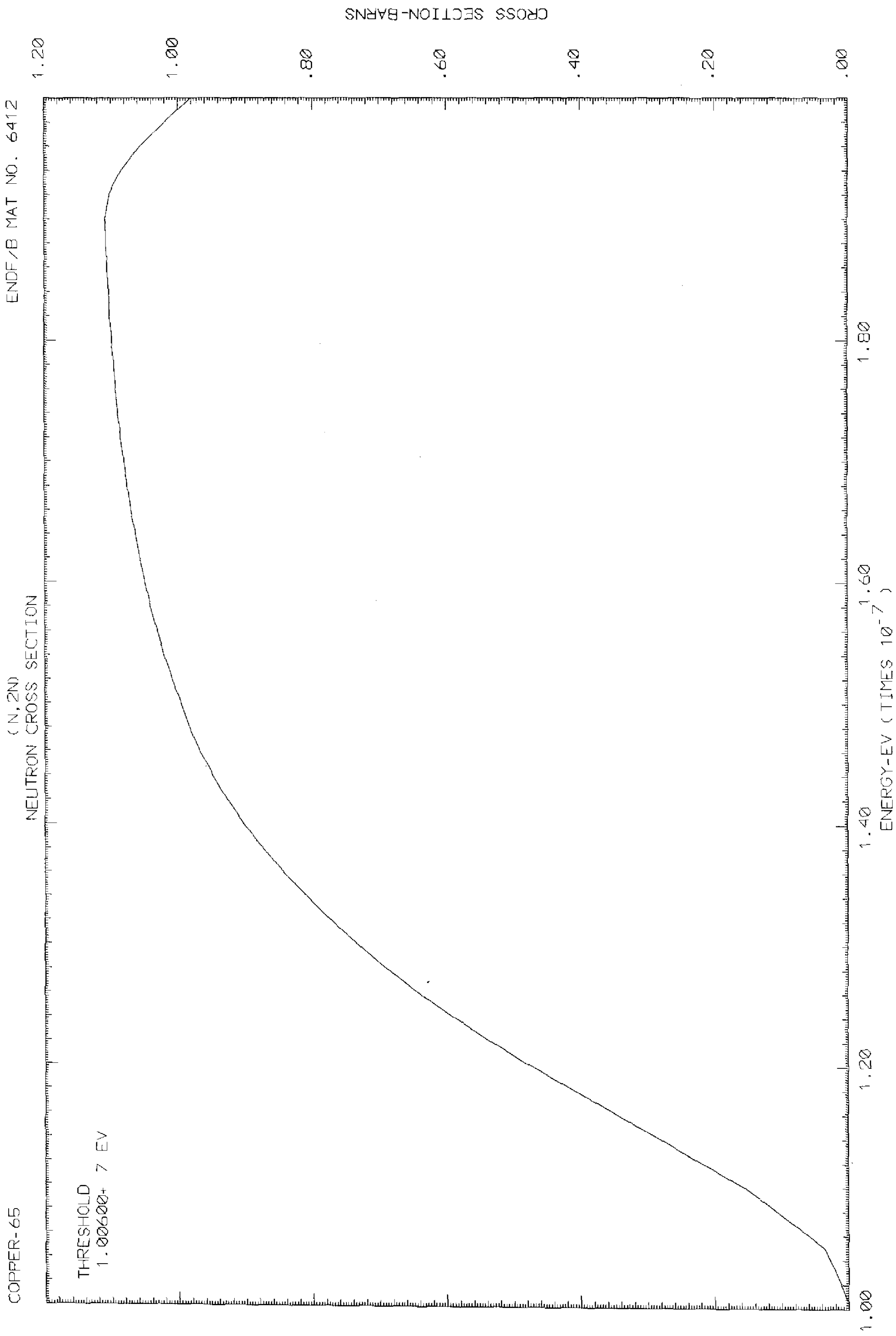
REACTION Q VALUE -9,9100E+06 EV

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION
1 TO 45	Y LINEAR IN X

NEUTRON CROSS SECTIONS

INDEX.	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	1,0060E+07	0,0000E+00	1,0500E+07	3.4580E-02	1,1000E+07	1,5440E-01	1.1500E+07	3.1340E-01	1,2000E+07	4,7540E-01
6	1,2200E+07	5,3470E-01	1,2400E+07	5,8990E-01	1,2600E+07	6,4110E-01	1,2800E+07	6,8850E-01	1,3000E+07	7,3240E-01
11	1,3200E+07	7,7280E-01	1,3400E+07	8,0990E-01	1,3600E+07	8,4400E-01	1,3800E+07	8,7510E-01	1,4000E+07	9,0320E-01
16	1,4200E+07	9,2820E-01	1,4400E+07	9,5010E-01	1,4600E+07	9,6890E-01	1,4800E+07	9,8440E-01	1,5000E+07	9,9680E-01
21	1,5200E+07	1,0100E+00	1,5400E+07	1,0220E+00	1,5600E+07	1,0320E+00	1,5800E+07	1.0420E+00	1,6000E+07	1,0500E+00
26	1,6200E+07	1,0580E+00	1,6400E+07	1,0640E+00	1,6600E+07	1,0710E+00	1,6800E+07	1,0760E+00	1,7000E+07	1,0810E+00
31	1,7200E+07	1,0860E+00	1,7400E+07	1,0900E+00	1,7600E+07	1,0930E+00	1,7800E+07	1.0960E+00	1,8000E+07	1,0990E+00
36	1,8200E+07	1,1020E+00	1,8400E+07	1,1040E+00	1,8600E+07	1,1060E+00	1,8800E+07	1.1080E+00	1,9000E+07	1,1090E+00
41	1,9200E+07	1,1030E+00	1,9400E+07	1,0850E+00	1,9600E+07	1,0560E+00	1,9800E+07	1.0202E+00	2,0000E+07	9,7960E-01


COPPER-65
THRESHOLD
1.00600+ 7 EV
(N,2N)
NEUTRON CROSS SECTION
ENDF/B MAT NO. 6412
CROSS SECTION-BARNS
1.20
1.00
.80
.60
.40
.20
.00
1.00
1.20
1.40
1.60
1.80
ENERGY-EV (TIMES 10^-7)

The $^{115}In(n,n')^{115m}In$ Reaction for ENDF/B-III

R. Sher

Stanford University

May 4, 1972

<u>$^{115}In(n,n')^{115m}In$, E_γ = 335 Kev, $T_{1/2}$ = 4.5 hours</u>

Several measurements exist[1-4,4a] of the energy-dependence of the cross section for excitation of the 4.5 hour, 335 keV isomeric state in ^{115}In by neutron inelastic scattering. There is also a calculation by Gardner[5], and some 14-MeV measurements.[6-8]

Ebel and Goodman[1] did relative measurements up to about 1.8 MeV, using an anthracene crystal for detection of the 335-keV gamma rays. They subsequently normalized their results to those of Martin et al.[2] at 0.88 MeV.

Martin et al.[2] measured the cross section up to 5 MeV, using a 1-1/2" x 2" NaI crystal for gamma-ray detection. They measured the neutron intensity with a long counter which had been calibrated with a Ra-Be source known to ±5%. They consider their data above 4 MeV suspect since the neutron angular distribution may have been in doubt, the neutron energy changing rapidly with angle in this region. For the gamma counting they assumed an internal conversion coefficient of 0.98, and a β^- branching ratio of 6%. The presently accepted value of the internal conversion coefficient is 0.90; this results in a 5% change in the cross sections.

Menlove et al.[3] used various reactions in a Van de Graaff Accelerator to cover the energy range from threshold to 8 MeV, and from 12 to about 19.5 MeV. Gamma-ray counting on 3" x 3" and 4" x 4" NaI crystals was employed. The cross section was determined relative to the fission cross section of ^{235}U in this energy region; the fission counter efficiency was calibrated at thermal energy. At 12.7 and 12.9 MeV the ^{27}Al(n,α) cross section was used for calibration. Menlove et al. used BNL-325 values of $\sigma_f(^{235}U)$; in the present report these have been replaced by ENDF-B-III values; the resulting change in the ^{115}In(n,n') cross sections is of the order of 5-10% in the energy region between 2 and 8 MeV.

Grench & Menlove[4] used gamma-ray counting on a calibrated 4" x 4" NaI crystal, and determined the cross section relative to that of $^{197}Au(n,\gamma)^{198}Au$. For the ^{197}Au(n,$\gamma$) values they used the 1966 evaluation of Vaughn and Grench.[11] These results have been renormalized to a later (1971) evaluation of Vaughn and Grench[12], and the new values, together with those of Martin et al., are shown in Fig. 1 and 2. Butler and Santry[4a] have made measurements from 0.8 to 6 MeV relative to a calibrated long counter, and at higher energies, calibrated against the $^{32}S(n,p)^{32}P$ cross section. These data are plotted in Fig. 2 as read off a curve prepared by Dudey and Kennerley; the original data are not available in published form.

In the 14 MeV region there are measurements by Heertje et al.[6] and Barrall et al.[7,8] Heertje et al. obtained 81.0 ± 5.6

mb at 14.6 MeV, normalized to the $^{56}Fe(n,p)$ cross section of 117 mb. Apparently this result was later revised to give a value for ^{115}In (n,n') of 55 ± 8 mb.[9] Barrall, Holmes, and Silbergeld[7] report a value of 67 ± 7 mb at 14.6 MeV, and Barrall, Silbergeld, and Gardner[8] report a value of 69 ± 5 mb at 14.8 MeV.

Gardner[5] has calculated this cross section from 2 to ∿ 10 MeV. These are absolute calculations, and the results are plotted as the dashed curve in Fig. 2. (The calculation does not include precompound nucleus evaporation.)

Gardner's calculations are about 10% higher than the measurements of Menlove, but support the relatively constant cross section from 4 to 8 MeV. There is other supporting evidence for this in older measurements of Cohen[10] and a broad-spectrum experiment of Heertje.[6] Below 4 MeV, all the experiments are in reasonably good agreement. The 14 MeV points of Heertje et al.[6] and Barrall et al.[7,8] are also in good agreement with Menlove's data. Most of these data are shown on Fig. 2.

Discussion

In Fig. 1 the low energy data, from threshold to about 2 MeV, are plotted. The data of Ebel and Goodman[1] and Martin et al.[2] have been slightly renormalized to account for the more recent value of the gamma rays per disintegration constant mentioned above. The data of Menlove et al.[3] and Grench and Menlove[4] have been renormalized to ENDF-B III values of the reference cross sections, $\sigma_f(^{235}U)$ and $\sigma_{n,\gamma}(^{197}Au)$, respectively. The recommended curve has been faired through the ensemble of points. The in-

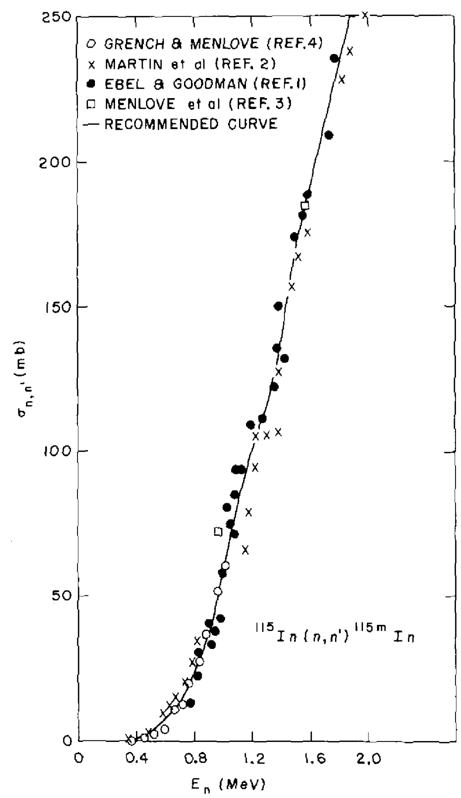


Figure 1

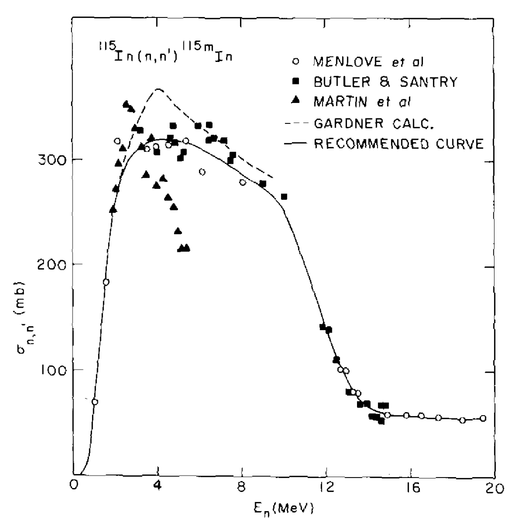


Figure 2

flection at 1.2-1.4 MeV is believed to be real; a similar behavior seems to be present in the cross section for excitation of the 0.91 MeV gamma ray at about the same energy.(13)

Above 2 MeV, the data are shown in Fig. 2, with the same renormalization as mentioned above. The recommended curve from 2 to 8 MeV is faired through the points of Menlove et al.(3) and Butler and Santry(4a); as has been noted, the data of reference (2) are suspect above 4 MeV. Gardner's calculation(5), while ∿10% higher than the measurements, further supports the relative flatness out to 8 MeV. Gardner's calculations are stated to have an uncertainty of at least the order of 10%, so there is no essential conflict between the calculations and the experimental data.

At higher energies, the recommended curve is faired through the available data which, in the neighborhood of 14.6-14.8 MeV, are all in reasonably good agreement. From 8 to 12 MeV, the curve is simply a guess designed to join the lower and higher energy regions smoothly. Neither experimental nor calculational data exist between 10 and 12 MeV.

References

1. A.A. Ebel and C. Goodman, Phys. Rev., 93, 197 (1954).

2. H.C. Martin, B.C. Diven, and R.F. Taschek, Phys. Rev., 93, 199 (1954).

3. H.O. Menlove, K.L. Coop, H.A. Grench, and R. Sher, Phys. Rev., 163, 1308 (1967).

4. H.A. Grench and H.O. Menlove, Phys. Rev., 165, 1298 (1968).

4a. J.P. Butler and D.C. Santry, A.P.S., 12, 547 (1967); and Private Communication quoted by N.D. Dudey.

5. D.G. Gardner, Private Communication to R. Sher.

6. I. Heertje, W. Nagel, and A.H.W. Aten, Jr., Physica, 30, 775 (1964); W. Nagel and A.H.W. Aten, Jr., Physica, 31, 1091 (1965).

7. R.C. Barrall, J.A. Holmes, and M. Silbergeld, AFWL-TR-68-134, Kirtland AFB (1969).

8. R.C. Barrall, M. Silbergeld, and D.G. Gardner, Nucl. Phys., A138, 387 (1969).

9. B.J. Mijheer, Private Communication to R.C. Barrall.

10. S.G. Cohen, Nature, 116, 475 (1948).

11. F.J. Vaughn, et al., Bull. Am. Phys. Soc., 11, 753 (1966).

12. F.J. Vaughn and H.A. Grench, Proc. of 3rd Conf. on Neutron Cross Sections and Technology, Vol. 1, 430 (1971).

13. BNL-325, 2nd Ed., Supplement No. 2, Vol. IIB.

INDIUM-115 INELASTIC NEUTRON CROSS SECTION ENDF/B MATERIAL NO. 6406

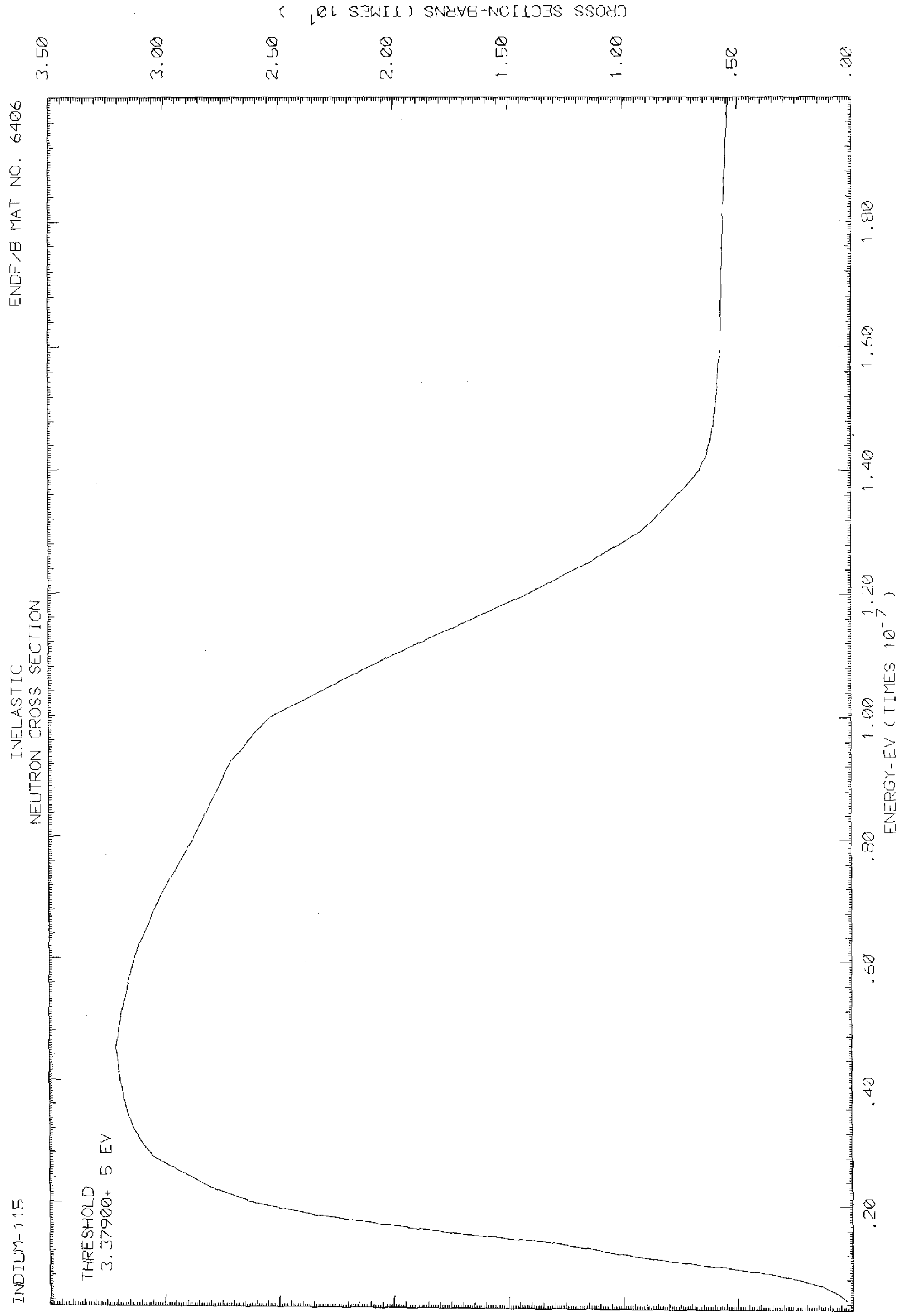
REACTION Q VALUE 3.3500E+05 EV

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION
1 TO 52	Y LINEAR IN X

NEUTRON CROSS SECTIONS

INDEX.	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	3.3790E+05	0.0000E+00	4.0000E+05	1.2500E-03	5.0000E+05	3.7500E-03	6.0000E+05	8.0000E-03	7.0000E+05	1.4000E-02
6	8.0000E+05	2.3500E-02	9.0000E+05	3.7000E-02	1.0000E+06	5.9000E-02	1.1000E+06	8.2000E-02	1.2000E+06	1.0100E-01
11	1.3000E+06	1.1600E-01	1.4000E+06	1.3600E-01	1.5000E+06	1.6700E-01	1.6000E+06	1.8900E-01	1.8000E+06	2.3200E-01
16	2.0000E+06	2.6000E-01	2.2500E+06	2.8000E-01	2.5000E+06	2.9200E-01	2.7500E+06	3.0500E-01	3.0000E+06	3.1000E-01
21	3.2500E+06	3.1400E-01	3.5000E+06	3.1600E-01	3.7500E+06	3.1800E-01	4.0000E+06	3.1900E-01	4.2500E+06	3.2000E-01
26	4.5000E+06	3.2100E-01	4.7500E+06	3.2000E-01	5.0000E+06	3.1900E-01	5.5000E+06	3.1600E-01	6.0000E+06	3.1300E-01
31	7.0000E+06	3.0200E-01	8.0000E+06	2.8700E-01	9.0000E+06	2.7400E-01	9.2500E+06	2.7100E-01	9.5000E+06	2.6500E-01
36	9.7500E+06	2.6000E-01	1.0000E+07	2.5300E-01	1.1000E+07	2.0000E-01	1.2000E+07	1.4100E-01	1.2500E+07	1.1500E-01
41	1.3000E+07	9.2000E-02	1.3500E+07	7.8000E-02	1.4000E+07	6.6000E-02	1.4250E+07	6.3000E-02	1.4500E+07	6.1000E-02
46	1.4750E+07	6.0000E-02	1.5000E+07	5.9000E-02	1.6000E+07	5.7000E-02	1.7000E+07	5.6500E-02	1.8000E+07	5.6000E-02
51	1.9000E+07	5.5000E-02	2.0000E+07	5.4000E-02						


INDIUM-115
INELASTIC
NEUTRON CROSS SECTION
ENDF/B MAT NO. 6406
THRESHOLD
3.37900+ 5 EV
CROSS SECTION-BARNS (TIMES 10 1)
3.50
3.00
2.50
2.00
1.50
1.00
.50
.00
.20
.40
.60
.80
1.00
1.20
1.40
1.60
1.80
ENERGY-EV (TIMES 10 7)

Evaluation of $^{115}In(n,\gamma)^{116}In$ For ENDF/B-IV

F. Schmittroth

Hanford Engineering and Development Laboratory

The evaluation of the $^{115}In(n,\gamma)^{116m}In$ metastable reaction described here is primarily for use in dosimetry. Emphasis was placed on File 2 (MT=151, resolved resonance parameters) and File 3 (MT=102, smooth capture cross sections).

Two metastable states exist for ^{116}In, a 54.2 min. state at 0.126 MeV and a shorter-lived state (2.2 sec) at 0.289 MeV that decays isomerically to the 54.2 min. state. Therefore, the metastable capture described here includes both isomeric states.

Resonance Parameters

The evaluation of resonance parameters is based on the new BNL resonance parameters.[1] Since the ℓ-values for these resonances are not given, s- and p- waves were assigned by a probability method[2] based on the neutron widths. Although this method is poor compared to more direct experimental evidence, assignments were unambiguous for most resonances. Typical probabilities for a particular p wave resonance were either less than 0.01 or greater than 0.80 so that a clean separation was obtained. On this basis, the number of s-wave resonances, N(E), up to an energy, E, was plotted as a function of energy. Numerical fitting procedures gave an average s-wave spacing,

D_{obs}, of (11.0 ± 0.7) eV. Also, since an inspection of the graph showed that resonances were being missed above 1 keV, the resolved-resonance range was terminated at that point. Except for the few cases where J-values were known, a value of J=4.5 was assigned for both s- and p-wave resonances. This unphysical value is appropriate for a ground state spin of I_o=9/2 for ^{115}In and provides a clue that the numbers are evaluated and not measured. A weighted average of radiation widths gives an average value of Γ_γ=(77 ± 5) mV. Because, as described below, capture to the ^{116}In isomeric states accounts for 79% of the total, all radiation widths were reduced by this factor.

Smooth Cross Sections

Above 1 keV, a standard Hauser-Feshbach calculation with width-fluctuation corrections[3] was performed for the isomeric capture cross section. By varying the ratio, Γ_γ/D_{obs}, the calculation was adjusted to an experimental value of 0.2 barns at an incident energy of 0.85 MeV. For the keV range, the primary data considered were from the work of Grench and Menlove[4] and Ryves et al.[5] Other data given consideration included measurements by Cox[6] and earlier work by Menlove et al.[7]

Other details required for the calculations include inelastic levels[8] taken from the compilation of Bass et al. Collective and direct capture were estimated by a phenomenological model for MeV energies.

Below 1 keV, a small "1/v" component was entered in File 3 to give a thermal cross section of 161 barns when added to the resonance contributions. Holden and Walker[9] recommend 41, 70 and 91 barns for the thermal cross sections leading to the ground state, and the first and second metastable states in ^{116}In, respectively (the total isomeric capture is 70 + 91=161 barns). Since the resonance parameters gave a thermal cross section of 157.09 barns, only 3.91 barns had to be added as the "1/v" component. Notice that the thermal isomeric to ground state cross section ratio is equal to 161/(161+41)=0.80. In the vicinity of 700 keV, this same ratio is close to 0.78; therefore a reduction of 0.79 for the capture widths was chosen for the resolved resonance parameters.

References

1. S.F. Mughabghab and D.I. Garber, BNL 325, 3rd Ed., Vol. 1, (Nat'l. Neutron Cross Section Center, Brookhaven Nat'l. Lab.) June 1973.

2. L.M. Bollinger and G.E. Thomas, Phys. Rev. 171, 1293 (1968).

3. F. Schmittroth, "Theoretical Calculations of Fast Neutron Capture Cross Sections", HEDL-TME 71, 106 (August 1971).

4. H.A. Grench and H.O. Menlove, Phys. Rev. 165, 1298 (1968).

5. T.B. Ryves et al., J. of Nuc. Energy, 27, 519 (1973).

6. S.A. Cox, Phys. Rev. 133, B 378 (1964).

7. H.O. Menlove et al., Phys. Rev. 163, 1299 (1967).

8. W.T. Bass et al., "Current Nuc. Level Schemes, A=91-117," ORNL-4627, (December 1970), (Nuclear Data Project, Oak Ridge Nat'l. Lab.).

9. N.E. Holden and F.W. Walker, Chart of the Nuclides, 11th Ed., Revised to April 1972 (Knolls Atomic Power Lab., General Electric Co., Schenectady, NY.).

INDIUM-115

RESONANCE DATA
RESONANCE PARAMETERS

ISOTOPE--------------------INDIUM-115
FRACTIONAL ABUNDANCE---------- 1.0000E+00
NUMBER OF ENERGY RANGES------ 1

ENERGY RANGE NUMBER---------- 1
LOWER ENERGY LIMIT (EV)------ 1.0000E-05
UPPER ENERGY LIMIT (EV)------ 1.0038E+03
NUCLEAR SPIN----------------- 4.5000E+00
SPIN SCATTERING LENGTH (A+)-- 6.5000E-01
NUMBER OF L STATES----------- 2

RESOLVED SINGLE-LEVEL BREIT-WIGNER PARAMETERS

L VALUE---------------------- 0
NUMBER OF RESONANCES--------- 89
SPIN SCATTERING LENGTH (A-)-- 0.0000E+00

			RESONANCE WIDTHS (EV)			
INDEX	ENERGY (EV)	J VALUE	TOTAL	NEUTRON	RADIATION	FISSION
1	1.4570E+00	5.0000E+00	5.9916E-02	3.0364E-03	5.6880E-02	0.0000E+00
2	3.8600E+00	4.0000E+00	6.4344E-02	3.5444E-04	6.3990E-02	0.0000E+00
3	9.1200E+00	5.0000E+00	6.4773E-02	1.5727E-03	6.3200E-02	0.0000E+00
4	1.2100E+01	4.5000E+00	1.1071E-01	1.1200E-04	1.1060E-01	0.0000E+00
5	2.2730E+01	4.5000E+00	6.5030E-02	1.0400E-03	6.3990E-02	0.0000E+00
6	2.3000E+01	4.5000E+00	6.4143E-02	1.1800E-03	6.2963E-02	0.0000E+00
7	3.9600E+01	4.5000E+00	6.4040E-02	4.0000E-03	6.0040E-02	0.0000E+00
8	4.6360E+01	4.5000E+00	6.3223E-02	2.6000E-04	6.2963E-02	0.0000E+00
9	4.8140E+01	4.5000E+00	7.1700E-02	6.0000E-04	7.1100E-02	0.0000E+00
10	6.3000E+01	4.5000E+00	7.5890E-02	8.4000E-04	7.5050E-02	0.0000E+00
11	6.9500E+01	4.5000E+00	6.3363E-02	4.0000E-04	6.2963E-02	0.0000E+00
12	8.0870E+01	4.5000E+00	5.6800E-02	1.5000E-03	5.5300E-02	0.0000E+00
13	8.3280E+01	4.5000E+00	6.4270E-02	6.6000E-03	5.7670E-02	0.0000E+00
14	9.4340E+01	4.5000E+00	7.4000E-02	2.9000E-03	7.1100E-02	0.0000E+00
15	1.2589E+02	4.5000E+00	5.5150E-02	3.8000E-03	5.1350E-02	0.0000E+00
16	1.3281E+02	4.5000E+00	1.4760E-01	5.4000E-03	1.4220E-01	0.0000E+00
17	1.5029E+02	4.5000E+00	7.1750E-02	4.6000E-03	6.7150E-02	0.0000E+00
18	1.6467E+02	4.5000E+00	8.2780E-02	1.8000E-02	6.4780E-02	0.0000E+00
19	1.6808E+02	4.5000E+00	6.5063E-02	2.1000E-03	6.2963E-02	0.0000E+00
20	1.7792E+02	4.5000E+00	6.6200E-02	3.0000E-03	6.3200E-02	0.0000E+00
21	1.8695E+02	4.5000E+00	9.9000E-02	2.0000E-02	7.9000E-02	0.0000E+00
22	2.0560E+02	4.5000E+00	8.5963E-02	2.3000E-02	6.2963E-02	0.0000E+00
23	2.1180E+02	4.5000E+00	6.3483E-02	5.2000E-04	6.2963E-02	0.0000E+00
24	2.2403E+02	4.5000E+00	7.9400E-02	3.2000E-02	4.7400E-02	0.0000E+00
25	2.2681E+02	4.5000E+00	6.4283E-02	1.3200E-03	6.2963E-02	0.0000E+00
26	2.5017E+02	4.5000E+00	1.2715E-01	6.0000E-02	6.7150E-02	0.0000E+00
27	2.6696E+02	4.5000E+00	6.6963E-02	4.0000E-03	6.2963E-02	0.0000E+00
28	2.8880E+02	4.5000E+00	8.2963E-02	2.0000E-02	6.2963E-02	0.0000E+00
29	2.9433E+02	4.5000E+00	1.0696E-01	4.4000E-02	6.2963E-02	0.0000E+00
30	3.1949E+02	4.5000E+00	7.7963E-02	1.5000E-02	6.2963E-02	0.0000E+00
31	3.3980E+02	4.5000E+00	6.4863E-02	1.9000E-03	6.2963E-02	0.0000E+00
32	3.5410E+02	4.5000E+00	6.9243E-02	6.2800E-03	6.2963E-02	0.0000E+00
33	3.6210E+02	4.5000E+00	7.3843E-02	1.0880E-02	6.2963E-02	0.0000E+00
34	3.7094E+02	4.5000E+00	6.9863E-02	6.9000E-03	6.2963E-02	0.0000E+00
35	3.8297E+02	4.5000E+00	6.4183E-02	1.2200E-03	6.2963E-02	0.0000E+00
36	3.8420E+02	4.5000E+00	6.8823E-02	5.8600E-03	6.2963E-02	0.0000E+00
37	4.0235E+02	4.5000E+00	9.4363E-02	3.1400E-02	6.2963E-02	0.0000E+00
38	4.1156E+02	4.5000E+00	9.4363E-02	3.1400E-02	6.2963E-02	0.0000E+00

39	4,2300E+02	4.5000E+00	7,3423E-02	1.0460E-02	6,2963E-02	0,0000E+00
40	4,3716E+02	4,5000E+00	6,4003E-02	1,0400E-03	6,2963E-02	0,0000E+00
41	4,4890E+02	4.5000E+00	7,5503E-02	1,2540E-02	6,2963E-02	0,0000E+00
42	4,5389E+02	4.5000E+00	8,3963E-02	2.1000E-02	6,2963E-02	0,0000E+00
43	4,5682E+02	4.5000E+00	8,2163E-02	1.9200E-02	6,2963E-02	0,0000E+00
44	4,6965E+02	4,5000E+00	6,8403E-02	5,4400E-03	6,2963E-02	0,0000E+00
45	4,7755E+02	4.5000E+00	6,6103E-02	3,1400E-03	6,2963E-02	0,0000E+00
46	4,9820E+02	4,5000E+00	6,5803E-02	2,9200E-03	6,2963E-02	0,0000E+00
47	5,0373E+02	4,5000E+00	8,7963E-02	2,5000E-02	6,2963E-02	0,0000E+00
48	5,1530E+02	4,5000E+00	6,6303E-02	3,3400E-03	6,2963E-02	0,0000E+00
49	5,2546E+02	4,5000E+00	7,7183E-02	1,4220E-02	6,2963E-02	0,0000E+00
50	5,4792E+02	4,5000E+00	6,8403E-02	5,4400E-03	6,2963E-02	0,0000E+00
51	5,5110E+02	4,5000E+00	6,4643E-02	1,6800E-03	6,2963E-02	0,0000E+00
52	5,7186E+02	4,5000E+00	9,8503E-02	3.5540E-02	6,2963E-02	0,0000E+00
53	5,8019E+02	4,5000E+00	7,0903E-02	7.9400E-03	6,2963E-02	0,0000E+00
54	5,8909E+02	4,5000E+00	6,9663E-02	6,7000E-03	6,2963E-02	0,0000E+00
55	6,0222E+02	4,5000E+00	6,5063E-02	2,1000E-03	6,2963E-02	0,0000E+00
56	6,1413E+02	4,5000E+00	1,0060E-01	3,7640E-02	6,2963E-02	0,0000E+00
57	6,1959E+02	4.5000E+00	7,9683E-02	1,6720E-02	6,2963E-02	0,0000E+00
58	6,4393E+02	4.5000E+00	6,7763E-02	4,8000E-03	6,2963E-02	0,0000E+00
59	6,4707E+02	4,5000E+00	6,8683E-02	5,7200E-03	6,2963E-02	0,0000E+00
60	6,5480E+02	4,5000E+00	7,1963E-02	9,0000E-03	6,2963E-02	0,0000E+00
61	6,7403E+02	4,5000E+00	7,4243E-02	1,1280E-02	6,2963E-02	0,0000E+00
62	6,8323E+02	4,5000E+00	6,6103E-02	3,1400E-03	6,2963E-02	0,0000E+00
63	6,9462E+02	4,5000E+00	6,7143E-02	4,1800E-03	6,2963E-02	0,0000E+00
64	7,0475E+02	4,5000E+00	6,5263E-02	2,3000E-03	6,2963E-02	0,0000E+00
65	7,0783E+02	4,5000E+00	6,8823E-02	5,8600E-03	6,2963E-02	0,0000E+00
66	7,1985E+02	4,5000E+00	6,6103E-02	3,1400E-03	6,2963E-02	0,0000E+00
67	7,2784E+02	4,5000E+00	6,6303E-02	3,3400E-03	6,2963E-02	0,0000E+00
68	7,3325E+02	4,5000E+00	7,5303E-02	1,2340E-02	6,2963E-02	0,0000E+00
69	7,5260E+02	4,5000E+00	6,5263E-02	2,3000E-03	6,2963E-02	0,0000E+00
70	7,7402E+02	4,5000E+00	8,3863E-02	2,0900E-02	6,2963E-02	0,0000E+00
71	7,8354E+02	4,5000E+00	7,8843E-02	1,5880E-02	6,2963E-02	0,0000E+00
72	7,8958E+02	4,5000E+00	7,9683E-02	1,6720E-02	6,2963E-02	0,0000E+00
73	7,9500E+02	4,5000E+00	6,8763E-02	5,8000E-03	6,2963E-02	0,0000E+00
74	8,1573E+02	4,5000E+00	6,6303E-02	3,3400E-03	6,2963E-02	0,0000E+00
75	8,1941E+02	4,5000E+00	7,1323E-02	8,3600E-03	6,2963E-02	0,0000E+00
76	8,2979E+02	4,5000E+00	7,3843E-02	1,0880E-02	6,2963E-02	0,0000E+00
77	8,3670E+02	4,5000E+00	8,0723E-02	1,7760E-02	6,2963E-02	0,0000E+00
78	8,5352E+02	4,5000E+00	1,2150E-01	5,8540E-02	6,2963E-02	0,0000E+00
79	8,6108E+02	4,5000E+00	8,5963E-02	2,3000E-02	6,2963E-02	0,0000E+00
80	8,6385E+02	4,5000E+00	8,1763E-02	1,8800E-02	6,2963E-02	0,0000E+00
81	8,7509E+02	4,5000E+00	6,9863E-02	6,9000E-03	6,2963E-02	0,0000E+00
82	8,9162E+02	4,5000E+00	7,8843E-02	1,5880E-02	6,2963E-02	0,0000E+00
83	8,9896E+02	4,5000E+00	6,6523E-02	3,5600E-03	6,2963E-02	0,0000E+00
84	9,1390E+02	4,5000E+00	7,6763E-02	1,3800E-02	6,2963E-02	0,0000E+00
85	9,2343E+02	4,5000E+00	6,9243E-02	6,2800E-03	6,2963E-02	0,0000E+00
86	9,4812E+02	4,5000E+00	1,1516E-01	5,2200E-02	6,2963E-02	0,0000E+00
87	9,5657E+02	4,5000E+00	9,4323E-02	3,1360E-02	6,2963E-02	0,0000E+00
88	9,7799E+02	4,5000E+00	9,9263E-02	3,6300E-02	6,2963E-02	0,0000E+00
89	9,9797E+02	4.5000E+00	9.6363E-02	3,3400E-02	6,2963E-02	0,0000E+00

L VALUE-------------------------- 1
NUMBER OF RESONANCES---------- 50
SPIN SCATTERING LENGTH (A*)-- 0.0000E+00

				RESONANCE WIDTHS (EV)		
INDEX	ENERGY (EV)	J VALUE	TOTAL	NEUTRON	RADIATION	FISSION
1	7.3080E+01	4.5000E+00	6.2975E-02	1.2000E-05	6.2963E-02	0.0000E+00
2	8.6360E+01	4.5000E+00	6.3015E-02	5.2000E-05	6.2963E-02	0.0000E+00
3	1.0083E+02	4.5000E+00	6.3007E-02	4.4000E-05	6.2963E-02	0.0000E+00
4	1.1090E+02	4.5000E+00	6.3011E-02	4.8000E-05	6.2963E-02	0.0000E+00
5	1.1443E+02	4.5000E+00	6.3067E-02	1.0400E-04	6.2963E-02	0.0000E+00
6	1.2071E+02	4.5000E+00	6.2971E-02	8.0000E-06	6.2963E-02	0.0000E+00
7	1.4404E+02	4.5000E+00	6.3109E-02	1.4600E-04	6.2963E-02	0.0000E+00
8	1.4576E+02	4.5000E+00	6.3023E-02	6.0000E-05	6.2963E-02	0.0000E+00
9	1.5859E+02	4.5000E+00	6.3109E-02	1.4600E-04	6.2963E-02	0.0000E+00
10	1.7408E+02	4.5000E+00	6.3163E-02	2.0000E-04	6.2963E-02	0.0000E+00
11	1.9224E+02	4.5000E+00	6.2995E-02	3.2000E-05	6.2963E-02	0.0000E+00
12	1.9442E+02	4.5000E+00	6.3087E-02	1.2400E-04	6.2963E-02	0.0000E+00
13	1.9883E+02	4.5000E+00	6.3035E-02	7.2000E-05	6.2963E-02	0.0000E+00
14	2.1409E+02	4.5000E+00	6.3139E-02	1.7600E-04	6.2963E-02	0.0000E+00
15	2.3928E+02	4.5000E+00	6.3217E-02	2.5400E-04	6.2963E-02	0.0000E+00
16	2.4674E+02	4.5000E+00	6.3155E-02	1.9200E-04	6.2963E-02	0.0000E+00
17	2.7677E+02	4.5000E+00	6.3099E-02	1.3600E-04	6.2963E-02	0.0000E+00
18	2.8228E+02	4.5000E+00	6.3149E-02	1.8600E-04	6.2963E-02	0.0000E+00
19	3.0252E+02	4.5000E+00	6.3067E-02	1.0400E-04	6.2963E-02	0.0000E+00
20	3.0837E+02	4.5000E+00	6.3089E-02	1.2600E-04	6.2963E-02	0.0000E+00
21	3.2957E+02	4.5000E+00	6.3163E-02	2.0000E-04	6.2963E-02	0.0000E+00
22	3.3673E+02	4.5000E+00	6.3163E-02	2.0000E-04	6.2963E-02	0.0000E+00
23	3.4518E+02	4.5000E+00	6.2993E-02	3.0000E-05	6.2963E-02	0.0000E+00
24	3.6060E+02	4.5000E+00	6.3163E-02	2.0000E-04	6.2963E-02	0.0000E+00
25	3.6687E+02	4.5000E+00	6.3303E-02	3.4000E-04	6.2963E-02	0.0000E+00
26	3.7910E+02	4.5000E+00	6.3591E-02	6.2800E-04	6.2963E-02	0.0000E+00
27	4.3121E+02	4.5000E+00	6.3183E-02	2.2000E-04	6.2963E-02	0.0000E+00
28	4.7358E+02	4.5000E+00	6.3523E-02	5.6000E-04	6.2963E-02	0.0000E+00
29	4.8801E+02	4.5000E+00	6.3603E-02	6.4000E-04	6.2963E-02	0.0000E+00
30	4.9367E+02	4.5000E+00	6.3463E-02	5.0000E-04	6.2963E-02	0.0000E+00
31	5.0188E+02	4.5000E+00	6.4003E-02	1.0400E-03	6.2963E-02	0.0000E+00
32	5.0621E+02	4.5000E+00	6.4043E-02	1.0800E-03	6.2963E-02	0.0000E+00
33	5.1312E+02	4.5000E+00	6.3061E-02	9.8000E-05	6.2963E-02	0.0000E+00
34	5.3011E+02	4.5000E+00	6.3903E-02	9.4000E-04	6.2963E-02	0.0000E+00
35	5.5970E+02	4.5000E+00	6.3603E-02	6.4000E-04	6.2963E-02	0.0000E+00
36	5.6261E+02	4.5000E+00	6.3903E-02	9.4000E-04	6.2963E-02	0.0000E+00
37	5.6962E+02	4.5000E+00	6.3483E-02	5.2000E-04	6.2963E-02	0.0000E+00
38	6.0999E+02	4.5000E+00	6.3803E-02	8.4000E-04	6.2963E-02	0.0000E+00
39	6.9915E+02	4.5000E+00	6.4183E-02	1.2200E-03	6.2963E-02	0.0000E+00
40	7.2410E+02	4.5000E+00	6.3963E-02	1.0000E-03	6.2963E-02	0.0000E+00
41	7.6006E+02	4.5000E+00	6.4043E-02	1.0800E-03	6.2963E-02	0.0000E+00
42	8.0063E+02	4.5000E+00	6.3863E-02	9.0000E-04	6.2963E-02	0.0000E+00
43	8.1252E+02	4.5000E+00	6.3463E-02	5.0000E-04	6.2963E-02	0.0000E+00
44	8.6944E+02	4.5000E+00	6.4543E-02	1.5800E-03	6.2963E-02	0.0000E+00
45	8.8258E+02	4.5000E+00	6.3723E-02	7.6000E-04	6.2963E-02	0.0000E+00
46	9.0676E+02	4.5000E+00	6.3543E-02	5.8000E-04	6.2963E-02	0.0000E+00
47	9.3194E+02	4.5000E+00	6.5243E-02	2.2800E-03	6.2963E-02	0.0000E+00
48	9.4374E+02	4.5000E+00	6.4063E-02	1.1000E-03	6.2963E-02	0.0000E+00
49	9.7381E+02	4.5000E+00	6.4203E-02	1.2400E-03	6.2963E-02	0.0000E+00
50	9.8176E+02	4.5000E+00	6.5863E-02	2.9000E-03	6.2963E-02	0.0000E+00

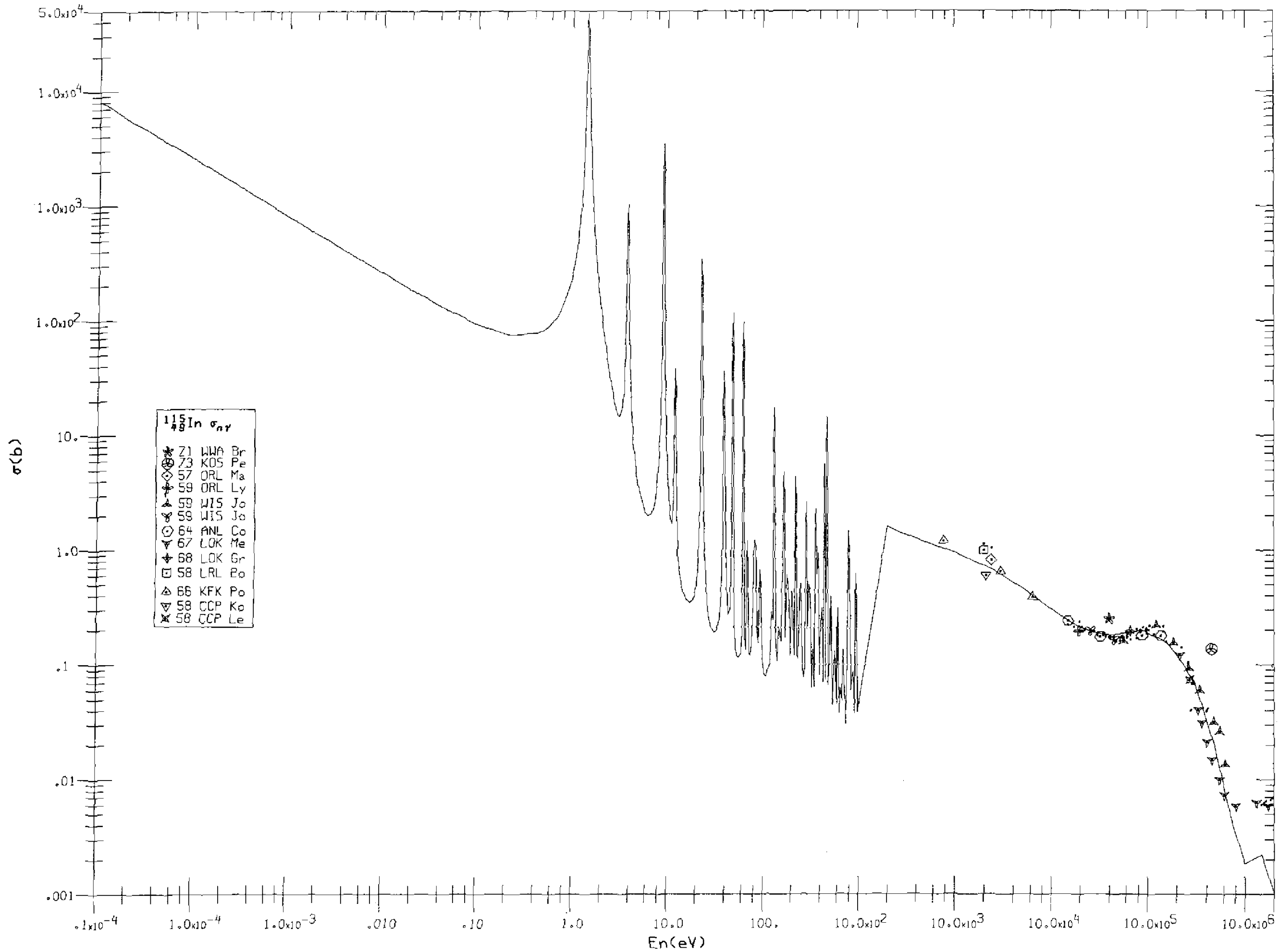
REACTION Q VALUE 6.5980E+06 EV

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION
1 TO 37	LN Y LINEAR IN LN X

NEUTRON CROSS SECTIONS

INDEX,	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	1.0000E-05	1.9667E+02	2.5300E-02	3.9100E+00	1.0038E+03	1.9630E-02	1.0038E+03	2.2057E+00	2.0000E+03	1.6000E+00
6	3.0000E+03	1.3760E+00	5.0000E+03	1.1740E+00	7.0000E+03	1.0620E+00	1.0000E+04	9.4550E-01	2.0000E+04	7.3050E-01
11	2.4000E+04	6.7660E-01	3.0000E+04	6.1080E-01	5.0000E+04	4.6280E-01	7.0000E+04	3.7680E-01	1.0000E+05	3.0280E-01
16	1.3000E+05	2.6050E-01	1.6000E+05	2.3400E-01	2.0000E+05	2.1210E-01	2.4000E+05	1.9870E-01	3.0000E+05	1.8750E-01
21	3.7000E+05	1.8140E-01	4.5000E+05	1.7980E-01	5.5000E+05	1.8280E-01	7.0000E+05	1.8960E-01	8.5000E+05	2.0010E-01
26	1.0000E+06	1.8800E-01	1.3000E+06	1.7020E-01	1.6000E+06	1.5340E-01	2.0000E+06	1.2070E-01	2.4000E+06	9.7030E-02
31	3.0000E+06	7.1310E-02	5.0000E+06	1.7810E-02	7.0000E+06	4.9540E-03	1.0000E+07	1.8430E-03	1.2000E+07	1.8720E-03
36	1.5000E+07	2.2160E-03	2.0000E+07	1.0000E-03						


$^{115}_{49}In\ \sigma_{n\gamma}$
71 WWA Br
73 KOS Pe
57 ORL Ma
59 ORL Ly
59 WIS Jo
59 WIS Jo
64 ANL Co
67 LOK Me
68 LOK Gr
58 LRL Po
66 KFK Po
58 CCP Ko
58 CCP Le
σ(b)
En(eV)

REFERENCES FOR EXPERIMENTAL DATA

^{115}In(n,γ)

Yr.	Lab	Author	References
73	KOS	Peto	Act. Phys. Ac. Sci. Hung. 33,363 (1973)
71	WWA	Brzosko, et al.	Acta Phys. Pol/B 2, 489 (1971)
68	LOK	Grench et al.	Phys. Rev. 165, 1298, (1968)
67	LOK	Menlove et al.	Phys. Rev. 163, 1299, (1967)
66	KFK	Poenitz	EANDC (E) - 66, 5, (1966)
64	ANL	Cox	Phys. Rev./B, 133, 378 (1964)
59	WIS	Johnsrud, et al.	Phys. Rev. 116, 927 (1959)
59	ORL	Lyon et al.	Phys. Rev. 114, 1619 (1959)
58	LRL	Booth	Phys. Rev. 112, 226 (1958)
58	CCP	Kononov, et al.	At. En. 5, 564 (1958)
58	CCP	Leipunsky, et al.	Second Peaceful Uses of At. En. Conf. Geneva Vol 15, 50 (1958)
57	ORL	Macklin et al.	Phys. Rev. 107, 504 (1957)

The $^{127}I(n,2n)^{126}I$ Cross-Section for ENDF/B-IV

R. Sher

Stanford University

May 1, 1972

$^{127}I(n,2n)^{126}I$, $Q = -9.15 \pm 0.20$ MeV, $E_{th} = 9.23 \pm 0.20$ MeV

Relative cross sections for this reaction have been measured from 13.2 Mev to 18 Mev[1] and from 12.4 Mev to 18.3 Mev[2]. In addition, there are a number of measurements at single energies in the vicinity of 14.6 Mev,[3-6] and calculated cross-section curves by Pearlstein[7] and Gardner[8]. Several measurements of cross-sections averaged over a broad neutron spectrum also exist[9,10].

In reference (1), a thin tritium target was bombarded by 3 MeV deuterons. The cross-section values were normalized relative to $\sigma\ ^{27}A\ell(n,\alpha)^{24}Na$ = 107 107 $\pm$ 5 mb at 15.21 Mev. NaI counting of ^{126}I decay gammas was employed with assumed branching ratios of 29% for the 386 keV gamma ray and 33% for the 667 keV gamma ray. Presently accepted values[9] for these branching ratios are 34% and 33%, respectively; the present values would lower the reported cross-sections by 62/67 = 0.925.

In reference (2), a NaI crystal was used as a combination target and detector. In addition to relative counting, σ_{rel} was also based on the angular distribution of (d,t) neutrons, known at the time to $\pm$ 10%. The relative cross-sections were normalized at 14.1 MeV in a separate experiment using a Cockroft-Walton generator and monitoring the neutron flux to ± 5% by means of the associated alpha particles.

In reference (3), the cross-section at 14.5 Mev was determined by beta-counting, with an uncertainty of ± 35%. In reference (4), gamma counting was used, and the cross section was determined at 14.6 ± 0.2 Mev relative to $\sigma\ ^{27}Al(n,\alpha)^{24}Na$ = 120.7 mb. The value obtained was 1.66 ± 0.15 barns. In reference (5), gamma counting was used, and the neutron flux was determined with a proton recoil telescope. The neutron energy was 14.8 ± 0.2 Mev. The cross-section obtained was 1.67 ± 0.09 barns. In reference (6), the cross-section was determined at 14.7 Mev relative to $\sigma^{27}Al(n,\alpha)^{24}$ Na = 112 mb. Gamma-ray counting with a NaI crystal was used. Chemical separation was employed to remove Sb resulting from $^{127}I(n,\alpha)^{123}Sb$. The efficiency of the NaI crystal was determined using Heath's curves, and a graphical spectrum-peeling procedure was used. The cross-section obtained was 1.64 ± 0.15 barns. However, the $^{27}Al(n,\alpha)$ cross-section used for normalization seems low, and should be 120 mb; this would raise the $^{127}I(n,2n)$ cross-section to 1.76 ± 0.16 barns.

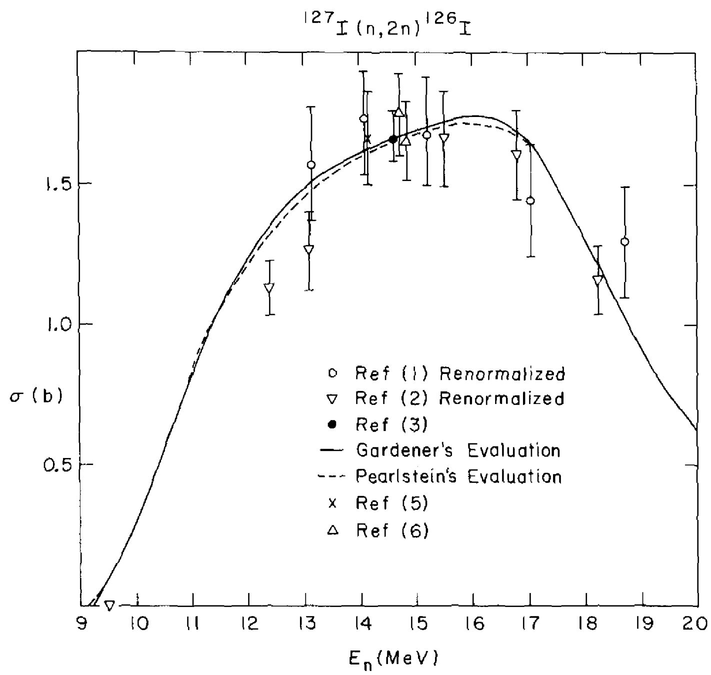
Pearlstein's calculated cross-sections[7] are relative; he normalized to a neutron emission cross-section, σ_{nM} = 1.380 barns, which makes the peak (n,2n) cross-section around 14.5 MeV have a value of about 1.3 barns. Gardner's calculation[8] is absolute, and gives a peak (n,2n) cross-section at 16 MeV of 1.65 barns, and a value at 14.7 MeV of 1.59 barns.

It is seen that measurements up to 1968 give a peak (n,2n) cross-section at ∿ 14.5 MeV of ∿ 1.3 barns; measurements since 1968 give a peak cross-section ∿ 1.7 barns. There are no obvious explanations for this discrepancy. The later measurements are favored on two grounds, however. First, they are more recent; second, Gardner's calculations, which are absolute in the sense that they are not normalized to any assumed cross-sections, favor the higher values.

In Fig. 1, the data of references (1), (2), (4-6), are compared with Gardner's calculated curve. The experimental data of (1) and (2) have been renormalized at 14.1 Mev to agree with Gardner's curve. Gardner's curve extends to 17 Mev; the region from 17-20 Mev has been calculated by Pearlstein's method, normalized to Gardner's value at 17 Mev.

There are two measurements of the average cross-section in a fission spectrum[9,10]. These (0.647 mb, 1.62 mb) differ by more than a factor of two, and therefore are of no help in normalizing the differential cross-section curve. The recommended curve (Gardner's calculation) yields an average cross-section in a Watt spectrum of 1.1 mb, which is close to the average of the two measured values.

The recommended curve for ENDF-B-IV is that in Fig. 1 (solid curve).



$^{127}I(n,2n)^{126}I$
1.5
1.0
0.5
σ (b)
Ref (1) Renormalized
Ref (2) Renormalized
Ref (3)
Gardener's Evaluation
Pearlstein's Evaluation
Ref (5)
Ref (6)
9
10
11
12
13
14
15
16
17
18
19
20
E_n (MeV)

Figure 1

References

1. M. Bormann, et al., Z. Phys. 166, 477 (1962).

2. H. L. Martin and R. F. Taschek, Phys. Rev. 89, 1302 (1953).

3. E. B. Paul and R. L. Clarke, Can. J. Phys. 31, 367 (1953).

4. R. C. Barrall, J. A. Holmes, and M. Silbergeld, Kirtland USAF Base, New Mexico, AFWL-TR-68-134 (1969).

5. R. C. Barrall, M. Silbergeld, and D. G. Gardner, Nucl. Phys. A-138, 387 (1969).

6. Havlik, Acta Physica Austriaca, 34, 209 (1971).

7. S. Pearlstein, Nucl. Sci. Eng. 23, 238 (1965).

8. D. G. Gardner, private communication.

9. D. DeRegge, R. Dams, and J. Hoste, Radiochimica Acta, Band 9, Heft 2/3, 57 (1968).

10. F. Nasyrov, Soviet J. Atomic Energy 25, 1251 (1967) (English transl.).

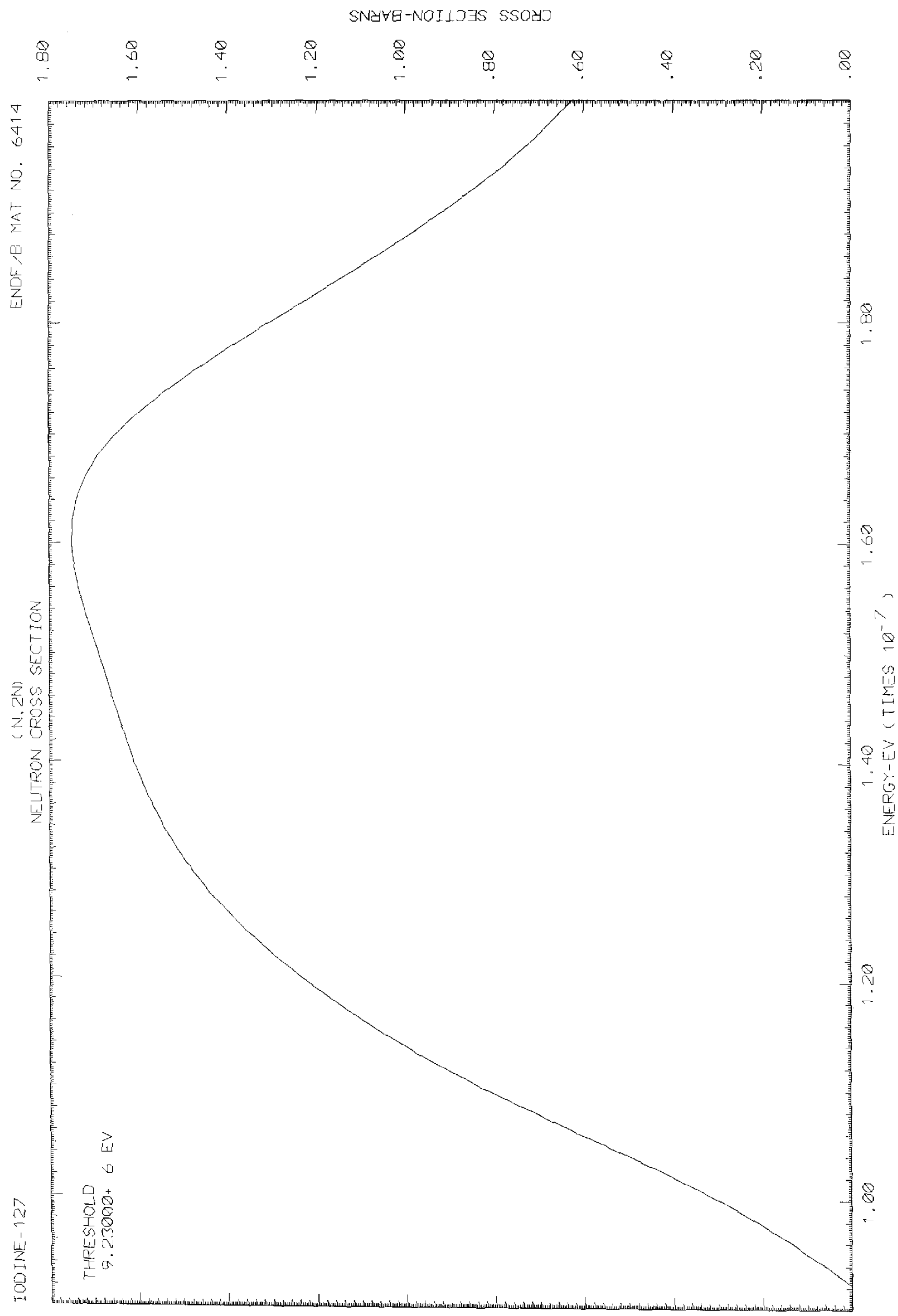
REACTION Q VALUE -9.1500E+06 EV

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION
1 TO 71	Y LINEAR IN X

NEUTRON CROSS SECTIONS

INDEX.	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	9,2300E+06	0.0000E+00	9,2840E+06	1.8362E-02	9,3380E+06	3,7043E-02	9,3920E+06	5.6043E-02	9,4460E+06	7,5362E-02
6	9,5000E+06	9.5000E-02	9,6000E+06	1.3227E-01	9,7000E+06	1,7102E-01	9,8000E+06	2.1164E-01	9,9000E+06	2,5450E-01
11	1,0000E+07	3,0000E-01	1,0100E+07	3,4835E-01	1,0200E+07	3,9913E-01	1.0300E+07	4.5172E-01	1,0400E+07	5,0555E-01
16	1,0500E+07	5.6000E-01	1,0600E+07	6,1452E-01	1,0700E+07	6,6867E-01	1,0800E+07	7.2207E-01	1,0900E+07	7,7431E-01
21	1,1000E+07	8,2500E-01	1,1100E+07	8,7381E-01	1,1200E+07	9,2070E-01	1.1300E+07	9.6568E-01	1.1400E+07	1.0088E+00
26	1,1500E+07	1,0500E+00	1,1600E+07	1.0894E+00	1,1700E+07	1.1270E+00	1.1800E+07	1.1629E+00	1,1900E+07	1,1972E+00
31	1,2000E+07	1.2300E+00	1,2200E+07	1.2912E+00	1,2400E+07	1,3467E+00	1.2600E+07	1.3966E+00	1,2800E+07	1.4410E+00
36	1,3000E+07	1.4800E+00	1,3200E+07	1.5139E+00	1,3400E+07	1,5431E+00	1.3600E+07	1.5684E+00	1,3800E+07	1.5905E+00
41	1,4000E+07	1,6100E+00	1,4200E+07	1.6276E+00	1,4400E+07	1,6438E+00	1.4600E+07	1.6592E+00	1,4800E+07	1.6744E+00
46	1,5000E+07	1,6900E+00	1,5200E+07	1,7062E+00	1,5400E+07	1,7218E+00	1.5600E+07	1.7353E+00	1,5800E+07	1,7452E+00
51	1,6000E+07	1,7500E+00	1,6200E+07	1,7482E+00	1,6400E+07	1,7386E+00	1.6600E+07	1.7198E+00	1.6800E+07	1,6907E+00
56	1,7000E+07	1,6500E+00	1,7200E+07	1,5970E+00	1,7400E+07	1,5336E+00	1.7600E+07	1.4622E+00	1,7800E+07	1,3852E+00
61	1,8000E+07	1,3050E+00	1,8200E+07	1,2239E+00	1,8400E+07	1,1432E+00	1.8600E+07	1.0641E+00	1,8800E+07	9.8764E-01
66	1,9000E+07	9,1500E-01	1,9200E+07	8,4711E-01	1,9400E+07	7,8417E-01	1.9600E+07	7.2617E-01	1,9800E+07	6,7311E-01
71	2,0000E+07	6,2500E-01								


IODINE-127
NEUTRON CROSS SECTION
(N,2N)
ENDF/B MAT NO. 6414
THRESHOLD
9.23000+ 6 EV
CROSS SECTION-BARNS
ENERGY-EV (TIMES 10^-7)

$^{197}Au(n,\gamma)^{198}Au$ Reaction for ENDF/B-IV*

M.D. Goldberg and S.F. Mughabghab

Brookhaven National Laboratory

The capture cross section in the ENDF/B-IV File below 2 keV is represented by the resonance parameters. In the energy region, 2-10 keV, the capture cross section was calculated by using the average resonance parameters specified in File 2 and the code AVRAGE-4[(1)] which follows the method of Lane and Lynn[(2)] and applies width fluctuation corrections as discussed in their paper. This calculated curve is shown in Fig. 1 compared with the avail-

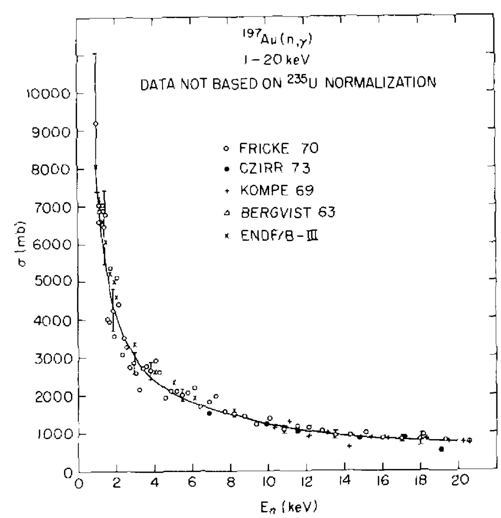


Figure 1

*Extracted from "Evaluated Neutron Cross Sections of ^{197}Au" BNL 50439 (ENDF-215) 74, S.F. Mughabghab et al.

able data in this range and with the ENDF/B-III valves between 1 and 6 keV. (The curve above 10 kev is the same as that of Fig. 4.)

For neutron energies greater than 25 keV, a reassessment of the gold capture cross section is required because of the availability of new measurements and because of a reevaluation of the ^{235}U cross section for ENDF/B-IV. Fig. 2 shows the new ^{235}U fission cross section between 25 and 100 keV. It can be immediately seen that there is considerable structure in this cross section, with fluctuations of as much as 10% or more within a kilovolt or so. Thus, its use as a standard is quite compromised unless the neutron energy and neutron energy spread are well known and accounted for. In Fig. 3 this cross section is "smeared out" by averaging points in groups of ten (effective "resolution" ∿5 keV) and compared to a similar curve for the ^{235}U fission cross section in ENDF/B-III. This plot indicates an average change in the absolute value of the cross section of 5-15%.

Since it would seem that a fluctuating cross section subject to substantial renormalization, does not make a very reliable

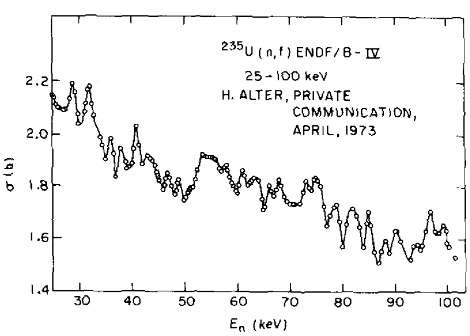


Figure 2

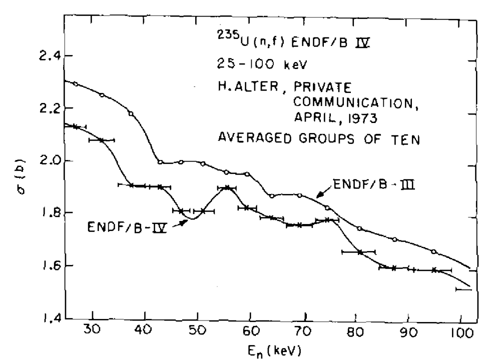


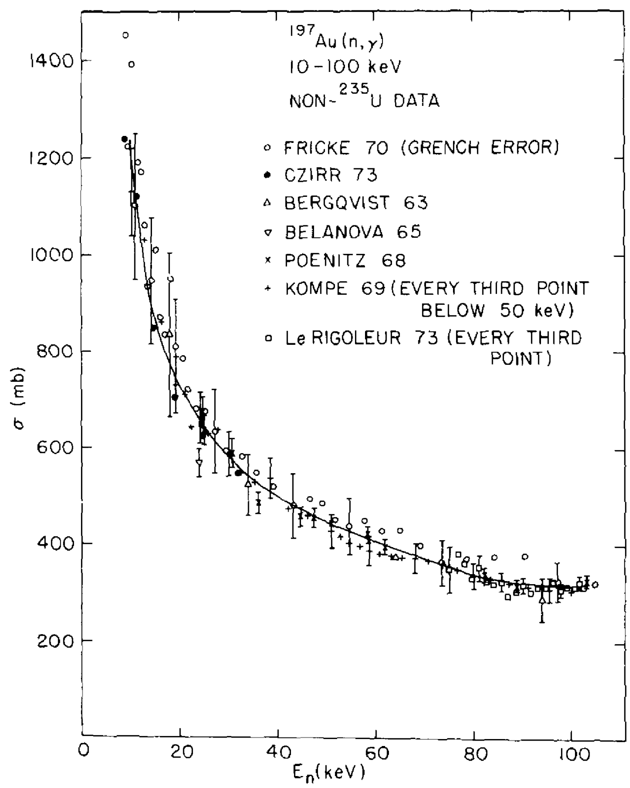
Figure 3

standard, it was decided to perform the gold capture re-evaluation with data not involving ^{235}U fission standardization. This follows the procedure adopted by Carlson[3] and by Poenitz[4] in evaluations presented at the 1970 EANDC Normalization and Standards Conference held at Argonne National Laboratory and follows the most recent recommendations of the Normalization and Standards Subcommittee of CSEWG (July 1973). Due to an abundance of excellent recent experiments, it was also arbitrarily decided that only data measured since 1960 would be considered.

The capture cross between 10-100 keV is shown in Fig. 4. The following data sets were were plotted: (1) Czirr et al.[5] (2) LeRigoleur et al.[6] (3) Fricke et al.[7] (4) Kompe[8] (5) Poenitz et al.[9] (6) Belanova et al.[10] (7) and Bergvist.[11] The data of Spitz et al.[12] Moxon et al.[13] and Bilpuch et al.[14] were not used.

The capture cross section between 100-1000 keV is shown in Fig. 5. Data sets of Refs. 6-10 were plotted, plus the data sets of Barry.[15]

Inspection of Figs. 4 and 5 show that the various data sets are in quite good agreement with each other within the quoted



197Au(n,γ)
10-100 keV
NON-235U DATA
FRICKE 70 (GRENCH ERROR)
CZIRR 73
BERGQVIST 63
BELANOVA 65
POENITZ 68
KOMPE 69 (EVERY THIRD POINT BELOW 50 keV)
Le RIGOLEUR 73 (EVERY THIRD POINT)
σ (mb)
1400
1200
1000
800
600
400
200
0
20
40
60
80
100
En(keV)

Figure 4

errors. There is a general tendency for the data of Fricke et al.[7] (Fig. 4) and Barry[15] (Fig. 5) to be higher than others and for the data of Bergvist[11] to be lower; but all are never more than about two standard deviations from the mean. The one point of Belanova et al.[10] is about three standard deviations low. The evaluated eye-guide in Figs. 4 and 5 was drawn with no explicit weight factors for the various experiments.

For the region above 1 MeV, the only one significant new contribution is that of Lindner.[16] These data should be considered preliminary until published and were measured relative to ^{235}U, but the lack of measured fluctuations in the ^{235}U fission cross section at these high energies made it worthwhile to see what the new data indicated for gold capture. Fig. 6 shows two independently normalized data sets from Lindner[16] between 0.5 and 3 MeV. The curve between 0.5 and 1 MeV is that of Fig. 5 and above 1 MeV is that of ENDF/B-III. The data up to 2.2 MeV are in excellent agreement with the old evaluation. The two higher energy points are low by about 15% and 20% respectively. It was felt that it was not worthwhile to give these points sufficient weight to seriously distort the ENDF/B-III curve, which represents the best curve through all previous measurements. An added inducement for not trying a serious reassessment of all of the data above 1 MeV was the implications of the effect noted by Devaney.[17] Devaney points out the importance of a multiple reactions correction for reaction cross section measurements above approximately 100 keV. The correction is particularly important for

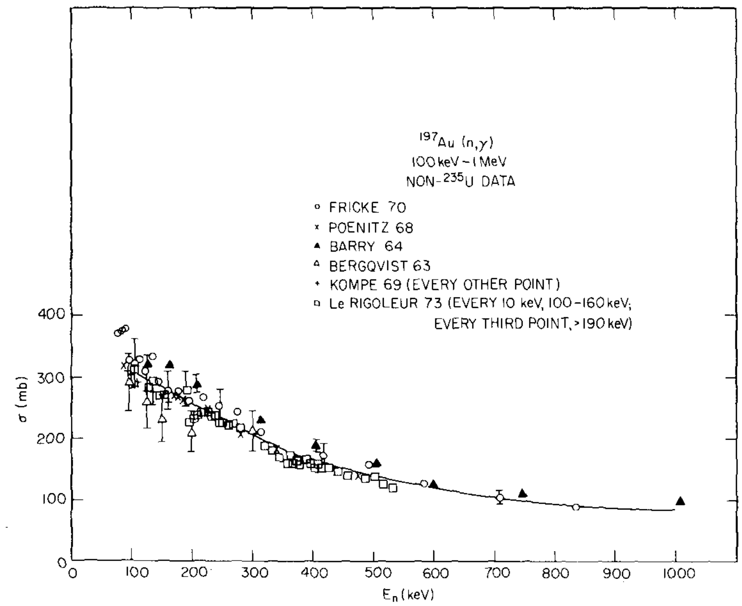


Figure 5

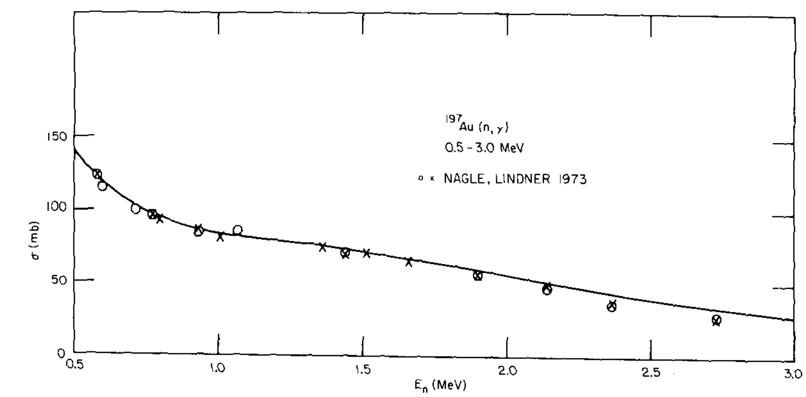


Figure 6

radiative capture, even with fairly thin samples. The relevance of this effect to specific gold capture experiments is unknown, but should be determined before the higher energy gold capture data are reevaluated again.

In conclusion, the evaluated curve of ENDF/B-III between 1 and 20 MeV, which included the evaluation of Vaughn and Grench[18] (1.0 - 5.2 MeV) and that of Bogart[27] above 5.2 MeV, are adopted for ENDF/B-IV.

It is of interest to calculate the fission spectrum averages of the capture and other reaction cross sections and compare them with experimental measurements. For this purpose, a Maxwellian ^{252}Cf fission spectrum of characteristic temperature 1.39 MeV and represented by

$$\phi(E) = C\sqrt{E}\, e^{-E/T}$$

was used. (C is a normalizing constant.) The calculated fission spectrum average of the ENDF/B-IV (n,γ) reaction of gold is 81.8 mb. This number is to be compared with an experimental value of 95.5 ± 2.3 mb measured by Pauw and Aten.[19] Since the capture section in the whole energy range 0.100-1.5 MeV is believed to be known to better than 18%, the source of this discrepancy could be due to either the measurement and/or the inadequacy of representing the fission spectrum by a Maxwellian form at low energies. The ^{235}U fission spectrum average measurements of Fabry[20] shed some light on the former explanation. Fabry obtains a value of 88.0 ± 4.5 mb for $^{197}Au(n,\gamma)^{198}Au$ reaction. With a characteristic temperature T = 1.32 MeV for ^{235}U, we obtain a fission spectrum average of 84.9 mb which is within the stated error of Fabry.[20]

After the completion of the evaluation of the capture cross section of Au, it was found that two points had been inadvertently omitted from consideration. Both were measured with the same technique at the National Physical Laboratory in England. At 25 keV, Ryves et al.[21] measured a value of 640 ± 25 mb. This is in excellent agreement with the value of 648 mb read from Fig. 4. At 966 keV, Robertson et al.[22] measured a value of 96.2 ± 2.0 mb. This value is approximately 12% higher than the value at this energy from Fig. 5. No changes were made as a result of this discrepancy for the reasons noted above regarding the Devaney[17] multiple reaction correction effect. In addition the following data sets become available at the time of the writing of the report:

(1) Poenitz[23] data in the energy range 400 - 3500 keV. This is an absolute measurement carried out by a large liquid scintillator for the detection of prompt capture gamma rays. The Grey Neutron Detector, the Black Neutron Detector and a ^{6}Li-glass detector were employed to measure and monitor the neutron flux.

(2) Macklin et al.[24] data in the energy range from 3 to 550 keV. In this measurement a scintillation detector and a ^{6}Li neutron monitor were used. The efficiency of the detector was normalized to the 4.9 eV gold resonance by the saturation method. The ^{6}Li neutron cross section of Uttley, slightly modified, was adopted.

(3) Rimawi and Chrien[25] using the iron filtered beam,

measured the neutron capture cross section of Gold at 24.5 keV by the activation method. Assuming a $^{10}B(n,\alpha\gamma)^{7}Li$ cross section of 3.487 b and a total reaction cross section of 5.9175 b for ^{10}B, they obtained a total capture cross section for ^{197}Au of 0.630 ± 0.006 b. The error indicated is only statistical and does not include the uncertainly in the normalization. These new measurements were plotted and compared with the ENDF/B-IV capture cross section in the pertinent energy regions. Good agreement is noted between the new measurements and the evaluated ENDF/B IV capture cross section.

Finally, it may be noted that preliminary results of the capture cross section of gold between 100 keV and 500 keV were reported by Fort[(26)] in a progress report. A $4\pi\beta\gamma$ detector was used to detect the induced activities. The data is not available at this time. Fort, however, made a comparison between his data and those of LeRigoleur and found reasonable agreement between the two measurements. These new data sets will be considered in the evaluation of the Au(n,γ) cross-section for ENDF/B-V.

<u>References</u>

1. M.R. Bhat, BNL 50296 (ENDF-148) June 1971.

2. A.M. Lane and J.E. Lynn, Proc. Phys. Soc. <u>A70</u>, 557 (1957).

3. A.D. Carlson, "Neutron Standards and Flux Normalization," ANL, 285, Oct. 21-23 (1970).

4. W.P. Poenitz, ibid p. 320.

5. J. B. Czirr and M.L. Stelts, Nucl. Sci. and Eng. <u>52</u>, 299 (1973). See also UCRL 74447 (Rev. 1) (June 1973).

6. C. LeRigoleur et al. "Contributions to Karlsruhe Meeting and Private Communication" (1973). See also Saclay Report CEA-N1662.

7. M.P. Fricke, W.M. Lopez, S.J. Friesenhahn, A.D. Carlson and D.G. Costello, "Proc. Nuclear Data for Reactors Conference," Helsinki, paper CN26/43 (1970).

8. D. Kompe, Nucl. Phys. <u>A133</u>, 513 (1969).

9. W.P. Poenitz, D. Kompe, and H.O. Menlove, J. Nucl. Eng. <u>22</u>, 505 (1968).

10. T.S. Belanova, A.A. Van'kov, F.F. Mikhailus, and Ya. Yo. Stavisski, At. Eng. <u>19</u>, 3 (1965). Translated in J. Nucl. Eng. <u>20</u>, 411 (1966).

11. I. Berqvist, Ark. Fys. <u>23</u>, 425 (1963).

12. L.M. Spitz, E. Barnard, and F.D. Brooks, Nucl. Phys. <u>A121</u>, 655 (1968).

13. M.C. Moxon and E.R. Rae, Nucl. Inst. Methods, <u>24</u>, 445 (1963).

14. E.G. Bilpuch, L.W. Weston, and H.W. Newson, Ann. Phys. <u>10</u>, 455 (1960).

15. J.F. Barry, J. Nucl. Energy <u>18</u>, 491 (1964).

16. M. Lindner, Private Communication (Feb. 1973).

17. J.J. Devaney, Nucl. Sci. and Eng. <u>51</u>, 272 (1973).

18. F.J. Vaughn and H.A. Grench, "Proc. Neutron Cross Sections and Technology Conference," 340, Knoxville (March 1971).

19. H. Pauw and A.H.W. Aten, Jr., J. Nucl. Energy <u>25</u>, 457 (1971).

20. A. Fabry, Report BLG463, May 1972. Volume appears in contribution by W.L. Zijp to the Conf. of Nucl. Data in Sci. and Technology, Volume II, p. 271, Paris (1972).

21. T.B. Ryves, J.C. Robertson, E.J. Axton, I. Goodier, and A. Williams, J. Nucl. Energy 20, 249 (1966).

22. J.C. Robertson, T.B. Ryves, E.J. Axton, I. Goodier, and A. Williams, J. Nucl. Energy 23, 205 (1969).

23. W.P. Poenitz, Private Communication (1974).

24. R.L. Macklin, J. Halperin, and R.R. Winters, Private Communication (1974). To be published in Phys. Rev.

25. K. Rimawi and R.E. Chrien, Private Communication (1974).

26. E. Fort EANDC(E), 157U, Vol. II, 29 (1973).

27. B. Bogart, "Proc. of Neutron Cross Sections and Technology Conference, 486, Washington (1966).

ISOTOPE--------------------------GOLD-197
FRACTIONAL ABUNDANCE---------- 1.0000E+00
NUMBER OF ENERGY RANGES------ 2

ENERGY RANGE NUMBER----------- 1 RESOLVED SINGLE-LEVEL BREIT-WIGNER PARAMETERS
LOWER ENERGY LIMIT (EV)------ 1.0000E-05
UPPER ENERGY LIMIT (EV)------ 2.0000E+03
NUCLEAR SPIN----------------- 1.5000E+00
SPIN SCATTERING LENGTH (A+)-- 9.6000E-01
NUMBER OF L STATES----------- 1

L VALUE---------------------- 0
NUMBER OF RESONANCES--------- 117
SPIN SCATTERING LENGTH (A+)-- 0.0000E+00

			RESONANCE WIDTHS (EV)			
INDEX	ENERGY (EV)	J VALUE	TOTAL	NEUTRON	RADIATION	FISSION
1	-2.5580E+01	2.0000E+00	1.7642E-01	5.2420E-02	1.2400E-01	0.0000E+00
2	4.9060E+00	2.0000E+00	1.3920E-01	1.5200E-02	1.2400E-01	0.0000E+00
3	4.6450E+01	1.0000E+00	1.2413E-01	1.3000E-04	1.2400E-01	0.0000E+00
4	5.8100E+01	1.0000E+00	1.1640E-01	4.4000E-03	1.1200E-01	0.0000E+00
5	6.0300E+01	2.0000E+00	1.9800E-01	6.8000E-02	1.3000E-01	0.0000E+00
6	7.8400E+01	1.0000E+00	1.4670E-01	1.6700E-02	1.3000E-01	0.0000E+00
7	1.0700E+02	2.0000E+00	1.2780E-01	7.8000E-03	1.2000E-01	0.0000E+00
8	1.2230E+02	2.0000E+00	1.2480E-01	8.0000E-04	1.2400E-01	0.0000E+00
9	1.4420E+02	1.0000E+00	1.2890E-01	8.9000E-03	1.2000E-01	0.0000E+00
10	1.5130E+02	2.0000E+00	1.4200E-01	2.2000E-02	1.2000E-01	0.0000E+00
11	1.6290E+02	1.0000E+00	1.8000E-01	5.0000E-02	1.3000E-01	0.0000E+00
12	1.6490E+02	2.0000E+00	1.1530E-01	9.3000E-03	1.0600E-01	0.0000E+00
13	1.9030E+02	1.0000E+00	1.7400E-01	4.4000E-02	1.3000E-01	0.0000E+00
14	2.0930E+02	2.0000E+00	1.2458E-01	5.8000E-04	1.2400E-01	0.0000E+00
15	2.4050E+02	2.0000E+00	1.7200E-01	7.2000E-02	1.0000E-01	0.0000E+00
16	2.5570E+02	1.0000E+00	1.2480E-01	8.0000E-04	1.2400E-01	0.0000E+00
17	2.6240E+02	1.0000E+00	2.5300E-01	1.3300E-01	1.2000E-01	0.0000E+00
18	2.7360E+02	2.0000E+00	1.0920E-01	4.2000E-03	1.0500E-01	0.0000E+00
19	2.9300E+02	2.0000E+00	5.1100E-01	3.6500E-01	1.4600E-01	0.0000E+00
20	3.2950E+02	2.0000E+00	1.7960E-01	4.5600E-02	1.3400E-01	0.0000E+00
21	3.3100E+02	1.0000E+00	2.0000E-01	6.2000E-02	1.3000E-01	0.0000E+00
22	3.5500E+02	2.0000E+00	1.6420E-01	3.9200E-02	1.2500E-01	0.0000E+00
23	3.7070E+02	2.0000E+00	1.9000E-01	8.4000E-02	1.0600E-01	0.0000E+00
24	3.7510E+02	1.0000E+00	1.4390E-01	1.3900E-02	1.3000E-01	0.0000E+00
25	3.8150E+02	2.0000E+00	1.6610E-01	6.1100E-02	1.0500E-01	0.0000E+00
26	4.0000E+02	2.0000E+00	1.6000E-01	2.0000E-02	1.4000E-01	0.0000E+00
27	4.4000E+02	1.0000E+00	4.2000E-01	2.8800E-01	1.3200E-01	0.0000E+00
28	4.5090E+02	2.0000E+00	1.7200E-01	6.2000E-02	1.1000E-01	0.0000E+00
29	4.7700E+02	2.0000E+00	4.5000E-01	3.2000E-01	1.3000E-01	0.0000E+00
30	4.9000E+02	1.0000E+00	1.8700E-01	5.7000E-02	1.3000E-01	0.0000E+00
31	4.9400E+02	2.0000E+00	1.6000E-01	2.7000E-02	1.3300E-01	0.0000E+00
32	5.3410E+02	2.0000E+00	1.6200E-01	3.5000E-02	1.2700E-01	0.0000E+00
33	5.4860E+02	1.0000E+00	1.8000E-01	5.3000E-02	1.2700E-01	0.0000E+00
34	5.7910E+02	2.0000E+00	5.2000E-01	3.7000E-01	1.5000E-01	0.0000E+00
35	5.8090E+02	1.0000E+00	2.6200E-01	1.4700E-01	1.1500E-01	0.0000E+00
36	5.8700E+02	1.0000E+00	1.6900E-01	3.5000E-02	1.3400E-01	0.0000E+00
37	6.0280E+02	2.0000E+00	3.6900E-01	2.2400E-01	1.4500E-01	0.0000E+00
38	6.1730E+02	2.0000E+00	2.3400E-01	7.4000E-02	1.6000E-01	0.0000E+00
39	6.2480E+02	1.0000E+00	1.7000E-01	4.9000E-02	1.2100E-01	0.0000E+00
40	6.2840E+02	2.0000E+00	1.6000E-01	2.2000E-02	1.3800E-01	0.0000E+00
41	6.3870E+02	2.0000E+00	6.3000E-01	4.8000E-01	1.5000E-01	0.0000E+00
42	6.5870E+02	1.0000E+00	1.3040E-01	6.4000E-03	1.2400E-01	0.0000E+00
43	6.8590E+02	1.0000E+00	1.3730E-01	1.3300E-02	1.2400E-01	0.0000E+00
44	6.9580E+02	1.0000E+00	8.3000E-01	6.6700E-01	1.6300E-01	0.0000E+00
45	6.9900E+02	2.0000E+00	8.8000E-01	7.3600E-01	1.4400E-01	0.0000E+00
46	7.1560E+02	2.0000E+00	2.8500E-01	1.1500E-01	1.7000E-01	0.0000E+00
47	7.3840E+02	2.0000E+00	1.3200E-01	8.0000E-03	1.2400E-01	0.0000E+00
48	7.5990E+02	1.0000E+00	5.8100E-01	4.2700E-01	1.5400E-01	0.0000E+00

49	7,7380E+02	1,0000E+00	6,0000E-01	4,7500E-01	1,2500E-01	0,0000E+00
50	7,8430E+02	2,0000E+00	2,8000E-01	1,2000E-01	1,6000E-01	0,0000E+00
51	7,9600E+02	2,0000E+00	3,2500E-01	1,7800E-01	1,4700E-01	0,0000E+00
52	8,1350E+02	1,0000E+00	1,4600E-01	2,2000E-02	1,2400E-01	0,0000E+00
53	8,1950E+02	2,0000E+00	3,8000E-01	2,3000E-01	1,5000E-01	0,0000E+00
54	8,2500E+02	2,0000E+00	7,0000E-01	5,3300E-01	1,6700E-01	0,0000E+00
55	8,6450E+02	1,0000E+00	1,7000E-01	2,3000E-02	1,4700E-01	0,0000E+00
56	8,7970E+02	2,0000E+00	1,7000E-01	3,5000E-02	1,3500E-01	0,0000E+00
57	9,3240E+02	2,0000E+00	5,6000E-01	4,1100E-01	1,4900E-01	0,0000E+00
58	9,6130E+02	1,0000E+00	2,6000E-01	1,0900E-01	1,5100E-01	0,0000E+00
59	9,8420E+02	2,0000E+00	4,8000E-01	3,3100E-01	1,4900E-01	0,0000E+00
60	9,8860E+02	2,0000E+00	2,9000E-01	1,2100E-01	1,6900E-01	0,0000E+00
61	9,9550E+02	2,0000E+00	6,5000E-01	4,9600E-01	1,5400E-01	0,0000E+00
62	1,0224E+03	1,0000E+00	1,2530E-01	1,3000E-03	1,2400E-01	0,0000E+00
63	1,0396E+03	1,0000E+00	1,6800E-01	4,4000E-02	1,2400E-01	0,0000E+00
64	1,0430E+03	1,0000E+00	6,1000E-01	4,8500E-01	1,2500E-01	0,0000E+00
65	1,0639E+03	2,0000E+00	1,3040E-01	6,4000E-03	1,2400E-01	0,0000E+00
66	1,0777E+03	1,0000E+00	4,8400E-01	3,6000E-01	1,2400E-01	0,0000E+00
67	1,0925E+03	2,0000E+00	5,2000E-01	3,7600E-01	1,4400E-01	0,0000E+00
68	1,1209E+03	1,0000E+00	1,4600E-01	2,2000E-02	1,2400E-01	0,0000E+00
69	1,1286E+03	2,0000E+00	1,6100E-01	3,7000E-02	1,2400E-01	0,0000E+00
70	1,1359E+03	2,0000E+00	4,9000E-01	3,3900E-01	1,5100E-01	0,0000E+00
71	1,1775E+03	2,0000E+00	1,3200E-01	8,0000E-03	1,2400E-01	0,0000E+00
72	1,1830E+03	2,0000E+00	4,3000E-01	2,9000E-01	1,4000E-01	0,0000E+00
73	1,2070E+03	2,0000E+00	5,0000E-01	3,6000E-01	1,4000E-01	0,0000E+00
74	1,2185E+03	2,0000E+00	1,5600E-01	3,2000E-02	1,2400E-01	0,0000E+00
75	1,2233E+03	1,0000E+00	7,0000E-01	5,6000E-01	1,4000E-01	0,0000E+00
76	1,2454E+03	1,0000E+00	2,5700E-01	1,3300E-01	1,2400E-01	0,0000E+00
77	1,2817E+03	1,0000E+00	6,0000E-01	4,5900E-01	1,4100E-01	0,0000E+00
78	1,2880E+03	2,0000E+00	1,3900E-01	1,5000E-02	1,2400E-01	0,0000E+00
79	1,3107E+03	2,0000E+00	3,7700E-01	2,5300E-01	1,2400E-01	0,0000E+00
80	1,3286E+03	1,0000E+00	8,4000E-01	7,0400E-01	1,3600E-01	0,0000E+00
81	1,3356E+03	2,0000E+00	2,4900E-01	1,2500E-01	1,2400E-01	0,0000E+00
82	1,3543E+03	1,0000E+00	7,2000E-01	5,9200E-01	1,2800E-01	0,0000E+00
83	1,3595E+03	2,0000E+00	1,5000E-01	2,6000E-02	1,2400E-01	0,0000E+00
84	1,3677E+03	1,0000E+00	3,9100E-01	2,6700E-01	1,2400E-01	0,0000E+00
85	1,3958E+03	2,0000E+00	1,5600E-01	3,2000E-02	1,2400E-01	0,0000E+00
86	1,4262E+03	1,0000E+00	3,8500E-01	2,6100E-01	1,2400E-01	0,0000E+00
87	1,4286E+03	2,0000E+00	5,5000E-01	4,2600E-01	1,2400E-01	0,0000E+00
88	1,4505E+03	2,0000E+00	4,1000E-01	2,7700E-01	1,3300E-01	0,0000E+00
89	1,4692E+03	2,0000E+00	1,6100E-01	3,7000E-02	1,2400E-01	0,0000E+00
90	1,4743E+03	1,0000E+00	2,8400E-01	1,6000E-01	1,2400E-01	0,0000E+00
91	1,4904E+03	2,0000E+00	1,1600E+00	1,0350E+00	1,2500E-01	0,0000E+00
92	1,5015E+03	1,0000E+00	1,5440E-01	3,0400E-02	1,2400E-01	0,0000E+00
93	1,5300E+03	1,0000E+00	1,7400E-01	5,0000E-02	1,2400E-01	0,0000E+00
94	1,5523E+03	2,0000E+00	3,0000E-01	1,5000E-01	1,5000E-01	0,0000E+00
95	1,5696E+03	1,0000E+00	1,3600E-01	1,2000E-02	1,2400E-01	0,0000E+00
96	1,5784E+03	1,0000E+00	6,4000E-01	4,8000E-01	1,6000E-01	0,0000E+00
97	1,5933E+03	2,0000E+00	1,8300E-01	5,9000E-02	1,2400E-01	0,0000E+00
98	1,6149E+03	2,0000E+00	2,8000E-01	1,6600E-01	1,1400E-01	0,0000E+00
99	1,6415E+03	1,0000E+00	2,4400E-01	1,2000E-01	1,2400E-01	0,0000E+00
100	1,6464E+03	2,0000E+00	2,2000E-01	9,6000E-02	1,2400E-01	0,0000E+00
101	1,6605E+03	1,0000E+00	1,3010E-01	6,1000E-03	1,2400E-01	0,0000E+00
102	1,6932E+03	2,0000E+00	2,5800E-01	1,3400E-01	1,2400E-01	0,0000E+00
103	1,7062E+03	2,0000E+00	3,9400E-01	2,7000E-01	1,2400E-01	0,0000E+00
104	1,7212E+03	2,0000E+00	1,6100E-01	3,7000E-02	1,2400E-01	0,0000E+00
105	1,7344E+03	2,0000E+00	4,3900E-01	3,1500E-01	1,2400E-01	0,0000E+00
106	1,7545E+03	2,0000E+00	4,4400E-01	3,2000E-01	1,2400E-01	0,0000E+00
107	1,7563E+03	1,0000E+00	6,9200E-01	5,6800E-01	1,2400E-01	0,0000E+00
108	1,8114E+03	1,0000E+00	2,2000E-01	9,6000E-02	1,2400E-01	0,0000E+00
109	1,8211E+03	2,0000E+00	1,3800E-01	1,4000E-02	1,2400E-01	0,0000E+00
110	1,8320E+03	1,0000E+00	2,1200E-01	8,8000E-02	1,2400E-01	0,0000E+00
111	1,8563E+03	1,0000E+00	1,5500E+00	1,3830E+00	1,6700E-01	0,0000E+00
112	1,8600E+03	2,0000E+00	2,1000E-01	8,6000E-02	1,2400E-01	0,0000E+00
113	1,8836E+03	1,0000E+00	3,5100E-01	2,2700E-01	1,2400E-01	0,0000E+00
114	1,8933E+03	2,0000E+00	1,2770E-01	3,7000E-03	1,2400E-01	0,0000E+00
115	1,9136E+03	1,0000E+00	2,6000E+00	2,4530E+00	1,4700E-01	0,0000E+00
116	1,9397E+03	1,0000E+00	6,5000E-01	5,2000E-01	1,3000E-01	0,0000E+00
117	1,9409E+03	2,0000E+00	9,0000E-01	7,3400E-01	1,6600E-01	0,0000E+00

ISOTOPE---------------------------GOLD-197
FRACTIONAL ABUNDANCE---------- 1.0000E+00
NUMBER OF ENERGY RANGES------ 2

ENERGY RANGE NUMBER---------- 2 UNRESOLVED SINGLE-LEVEL BREIT-WIGNER PARAMETERS
LOWER ENERGY LIMIT (EV)------ 2.0000E+03
UPPER ENERGY LIMIT (EV)------ 1.0000E+04
NUCLEAR SPIN----------------- 1.5000E+00
EFFECTIVE SCATTERING RADIUS-- 9.6000E-01
NUMBER OF L STATES----------- 2

L VALUE---------------------- 0
NUMBER OF J STATES----------- 2

LEVEL SPACING	J-VALUE	DEG OF FREEDOM	AVERAGE RESONANCE WIDTHS (EV) NEUTRON	RADIATION
4.3200E+01	1.0000E+00	1.0000E+00	9.0720E-03	1.2500E-01
2.5900E+01	2.0000E+00	1.0000E+00	5.4390E-03	1.2500E-01

L VALUE---------------------- 1
NUMBER OF J STATES----------- 4

LEVEL SPACING	J-VALUE	DEG OF FREEDOM	AVERAGE RESONANCE WIDTHS (EV) NEUTRON	RADIATION
1.2960E+02	0.0000E+00	1.0000E+00	5.1840E-03	1.2500E-01
4.3200E+01	1.0000E+00	2.0000E+00	1.7280E-03	1.2500E-01
2.5900E+01	2.0000E+00	2.0000E+00	1.0360E-03	1.2500E-01
1.8500E+01	3.0000E+00	1.0000E+00	7.4000E-04	1.2500E-01

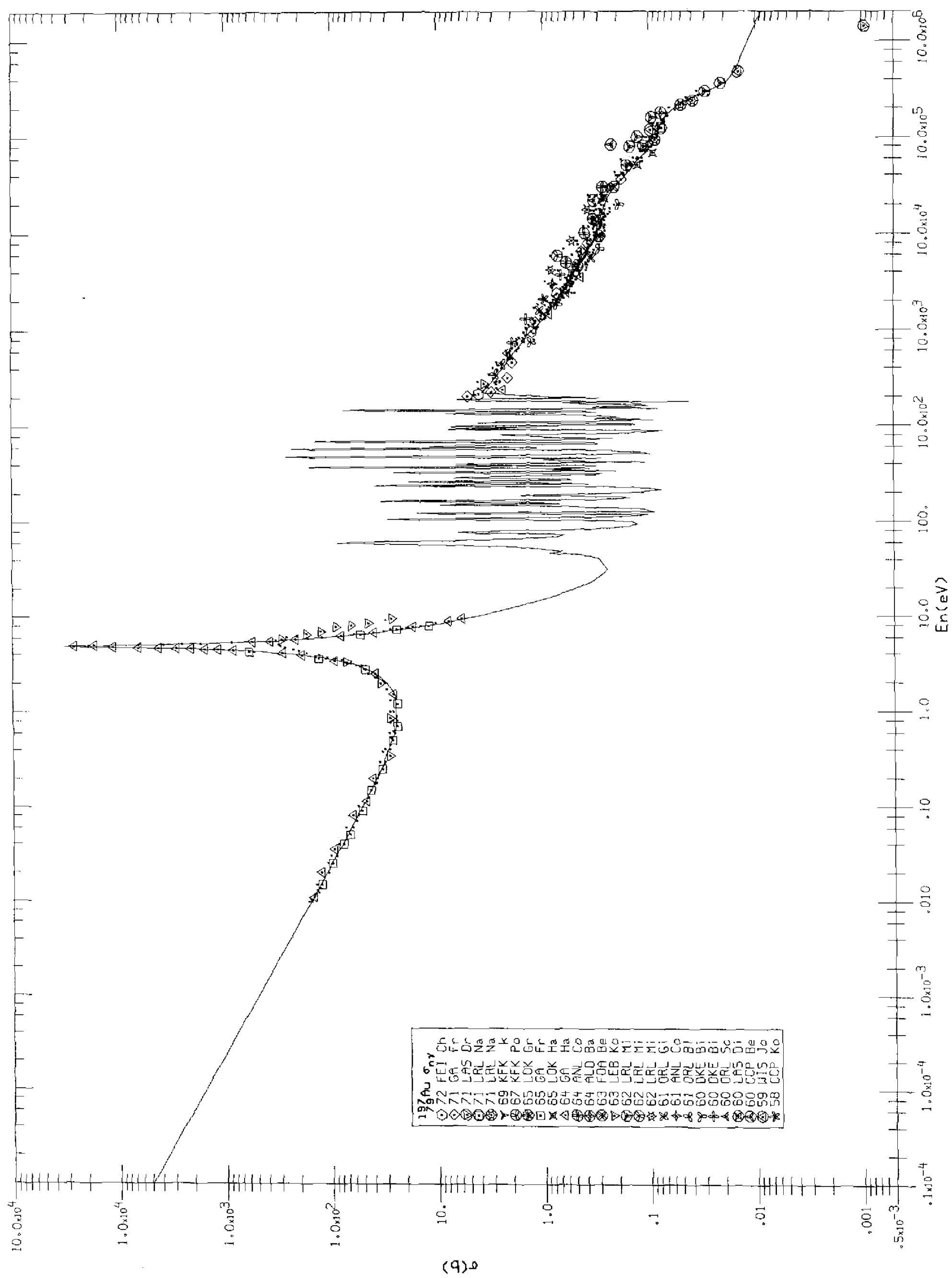
REACTION Q VALUE 6.4970E+06 EV

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION	RANGE	DESCRIPTION
1 TO 95	Y LINEAR IN X	95 TO 135	LN Y LINEAR IN LN X

NEUTRON CROSS SECTIONS

INDEX,	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	1.0000E-05	0.0000E+00	2.0000E+03	0.0000E+00	2.0000E+03	4.1340E-02	3.0000E+03	1.9020E-02	4.0000E+03	3.4130E-02
6	5.0000E+03	8.2240E-02	6.0000E+03	1.2182E-01	7.0000E+03	1.3143E-01	8.0000E+03	1.2623E-01	9.0000E+03	1.3054E-01
11	1.0000E+04	1.0318E-01	1.0000E+04	1.2250E+00	1.1000E+04	1.1400E+00	1.2000E+04	1.0500E+00	1.3000E+04	9.9000E-01
16	1.4000E+04	9.2500E-01	1.5000E+04	8.9000E-01	1.6000E+04	8.5000E-01	1.7000E+04	8.2000E-01	1.8000E+04	7.9000E-01
21	1.9000E+04	7.7000E-01	2.0000E+04	7.3500E-01	2.1000E+04	7.1600E-01	2.2000E+04	6.9800E-01	2.3000E+04	6.8250E-01
26	2.4000E+04	6.6400E-01	2.5000E+04	6.5000E-01	2.6000E+04	6.3800E-01	2.7000E+04	6.2300E-01	2.8000E+04	6.0900E-01
31	2.9000E+04	5.9700E-01	3.0000E+04	5.8400E-01	3.2000E+04	5.6600E-01	3.4000E+04	5.4800E-01	3.6000E+04	5.3000E-01
36	3.8000E+04	5.1250E-01	4.0000E+04	5.0100E-01	4.2000E+04	4.8900E-01	4.4000E+04	4.7900E-01	4.6000E+04	4.6900E-01
41	4.8000E+04	4.5900E-01	5.0000E+04	4.4900E-01	5.2000E+04	4.4000E-01	5.4000E+04	4.3100E-01	5.6000E+04	4.2300E-01
46	5.8000E+04	4.1700E-01	6.0000E+04	4.0800E-01	6.5000E+04	3.9000E-01	7.0000E+04	3.7250E-01	7.5000E+04	3.5750E-01
51	8.0000E+04	3.4100E-01	8.5000E+04	3.3000E-01	9.0000E+04	3.2600E-01	9.5000E+04	3.2000E-01	1.0000E+05	3.1300E-01
56	1.1000E+05	3.0700E-01	1.2000E+05	3.0100E-01	1.3000E+05	2.9500E-01	1.4000E+05	2.9000E-01	1.5000E+05	2.8300E-01
61	1.6000E+05	2.7900E-01	1.7000E+05	2.7300E-01	1.8000E+05	2.6800E-01	1.9000E+05	2.6200E-01	2.0000E+05	2.5750E-01
66	2.1000E+05	2.5100E-01	2.2000E+05	2.4500E-01	2.3000E+05	2.4100E-01	2.4000E+05	2.3500E-01	2.5000E+05	2.3000E-01
71	2.6000E+05	2.2500E-01	2.7000E+05	2.2000E-01	2.8000E+05	2.1600E-01	2.9000E+05	2.1200E-01	3.0000E+05	2.0800E-01
76	3.2000E+05	1.9800E-01	3.4000E+05	1.8900E-01	3.6000E+05	1.8100E-01	3.8000E+05	1.7100E-01	4.0000E+05	1.6500E-01
81	4.2000E+05	1.6000E-01	4.4000E+05	1.5400E-01	4.6000E+05	1.4800E-01	4.8000E+05	1.4300E-01	5.0000E+05	1.4000E-01
86	5.2000E+05	1.3500E-01	5.4000E+05	1.3100E-01	5.6000E+05	1.2800E-01	5.8000E+05	1.2300E-01	6.0000E+05	1.2000E-01
91	6.5000E+05	1.1100E-01	7.0000E+05	1.0400E-01	7.5000E+05	1.0000E-01	8.0002E+05	9.5000E-02	8.5000E+05	9.0000E-02
96	9.0000E+05	8.9000E-02	9.5000E+05	8.7000E-02	1.0000E+06	8.4450E-02	1.1000E+06	8.1730E-02	1.2000E+06	7.9530E-02
101	1.3000E+06	7.7530E-02	1.4000E+06	7.5200E-02	1.5000E+06	7.2610E-02	1.6000E+06	6.9800E-02	1.7000E+06	6.6810E-02
106	1.8000E+06	6.3680E-02	1.9000E+06	6.0460E-02	2.0000E+06	5.7170E-02	2.1000E+06	5.3860E-02	2.2000E+06	5.0560E-02
111	2.3000E+06	4.7300E-02	2.4000E+06	4.4090E-02	2.5000E+06	4.0980E-02	2.6000E+06	3.8000E-02	2.7000E+06	3.5500E-02
116	2.8000E+06	3.3100E-02	2.9000E+06	3.0700E-02	3.0000E+06	2.8400E-02	3.2000E+06	2.4600E-02	3.4000E+06	2.1900E-02
121	3.6000E+06	1.9900E-02	3.8000E+06	1.8700E-02	4.0000E+06	1.7800E-02	4.2000E+06	1.7100E-02	4.4000E+06	1.6600E-02
126	4.6000E+06	1.6100E-02	4.8000E+06	1.5700E-02	5.0000E+06	1.5400E-02	5.2000E+06	1.5200E-02	5.4000E+06	1.4900E-02
131	6.0000E+06	1.4300E-02	8.0000E+06	1.2700E-02	1.0000E+07	1.1600E-02	1.5000E+07	9.8000E-03	2.0000E+07	8.7000E-03



197 79 Au σnγ
72 FEI Ch
71 GA Fr
71 LAS Dr
71 LRL Na
71 LRL Na
69 KFK K
67 KFK Po
65 LOK Gr
65 GA Fr
65 LOK Ha
64 GA Ha
64 ANL Co
64 ALD Ba
63 FOA Be
63 LEB Ko
62 LRL Mi
62 LRL Mi
62 LRL Mi
61 ORL Gi
61 ANL Co
61 ORL Bi
60 DKE Bi
60 DKE Bi
60 ORL Sc
60 LAS Di
60 CCP Be
59 WIS Jo
58 CCP Ko
En(eV)
σ(b)

REFERENCES FOR EXPERIMENTAL DATA

$^{197}Au(n,\gamma)$

Yr.	Lab	Author	References
72	FEI	Chelnakov, et al.	Jad. Fiz. Iss. 13, 6 (1972)
71	GA	Fricke, et al.	Third Conf. Neutron Cross Sections & Tech., Knoxville, Tenn. Vol. I, 252 (1972)
71	LRL	Nagle, et al.	Third Conf. Neutron Cross Sections & Tech., Knoxville, Tenn. Vol. II, 251 (1971)
71	LAS	Drake, et al.	Phys. Lett/B 36, 557 (1971)
71	WWA	Brzosko, et al.	Acta Phys. Pol/B 2, 489 (1971)
69	KFK	Kompe	Nuc. Phys./A 133, 513 (1969)
68	GA	Friesenhahn, et al.	J. Nuc. En. 22, 191 (1968)
67	DEB	Peto, et al.	J. Nuc. En. 21, 797 (1967)
67	ORL	Macklin, et al.	Phys. Rev. 159, 1007 (1967)
67	KFK	Poenitz	Fast Reactor Phys. Symp. Karlsruhe, Vol I, 67 (1967)
66	KFK	Poenitz	J. Nuc. En. 20, 825 (1966)
66	KFK	Poenitz	Int. Conf. Nuc. Phys. Paris Vol I, 295 (1966)
65	MUA	Chaubey, et al.	Nuc. Phys. 66, 267 (1965)
65	LOK	Grench, et al.	EANDC-(US) 79, 72 (1965)
65	GA	Friesenhahn, et al.	GA-6832 (1965)
65	LOK	Harris, et al.	Nuc. Phys. 69, 37 (1965)
64	GA	Haddad, et al.	Nuc. Inst. & Meth. 36, 125 (1964)
64	ANL	Cox	Phys. Rev./B 133, 378 (1964)
64	ALD	Barry	J. Nuc. En. 18, 491 (1964)
63	FOA	Bergqvist	Ark. Fiz. 23, 425 (1963)
63	ORL	Macklin, et al	Nuc. Phys. 43, 353 (1963)
63	LEB	Konks, et al.	Zhur Ex. & Theor. Fiz. 46, 80 (1963)

REFERENCES FOR EXPERIMENTAL DATA

$^{197}Au(n,\gamma)$ cont'd

Yr.	Lab	Author	References
62	LRL	Miskel, et al.	Phys. Rev. 128, 2717 (1962)
61	ANL	Meadows, et al.	Nuc. Sci. & Eng. 9, 132 (1961)
61	ORL	Gibbons, et al	Phys. Rev. 122, 182 (1961)
61	ANL	Cox	Phys. Rev. 122, 1280 (1961)
61	ORL	Weston, et al.	Phys. Rev. 123, 948 (1961)
61	ORL	Block, et al.	Neut. T.O.F. Conf. Saclay, p. 203 (1961)
60	DKE	Bilpuch, et al.	An. Phys. 10, 455 (1960)
60	ORL	Schmitt, et al.	Nuc. Phys. 20, 202 (1960)
60	LAS	Diven, et al.	Phys. Rev. 120, 556 (1960)
60	CCP	Belanova	At. En. 8, 549 (1960)
59	LAS	Bame, et al.	Phys. Rev. 113, 256 (1959)
59	ORL	Lyon, et al.	Phys. Rev. 114, 1619 (1959)
59	WIS	Johnsrud, et al.	Phys. Rev. 116, 927 (1959)
59	HAR	Ferguson, et al.	J. Nuc. En. 10, 19 (1959)
58	LRL	Booth, et al.	Phys. Rev. 112, 226 (1958)
58	CCP	Kononov, et al.	At. En. 5, 564 (1958)

^{232}Th Cross Section Evaluation for ENDF/B-IV*,**

W.A. Wittkopf

Babcock & Wilcox

^{232}Th Cross Sections Below 50 keV

Capture Cross Sections in the Sub-resonance Region (0.001 to 10 eV)

The capture cross section of ^{232}Th in the thermal and near-thermal energy range deviates substantially from 1/v behavior; this is due to the large contribution from resonance levels whose energies are less than the neutron separation threshold. From 4.0 eV to approximately 10 eV, the capture cross-section profile is dominated by the 21.78 eV resonance level; this profile, however, is essentially unaffected by Doppler broadening even at normal reactor fuel temperatures. Thus, 10.0 eV was chosen as the cut-off between the sub-resonance and resolved resonance regions.

For any E in the sub-resonance region, the value of $\sigma_{n\gamma}(E)$ can be computed by summing contributions from the various positive and negative energy resonance levels. In this study, these contributions have been obtained with the single-level, Breit-Wigner formula corrected for Doppler-broadening:

$$\sigma_{n,\gamma}(E) = \sum_i \sigma_o^i \sqrt{\frac{E_i}{E}}\ \psi\ (x,\theta)$$

---

*This report is extracted from a draft copy of BAW-317.

**This ^{232}Th evaluation is a version II set updated at the NNCSC to meet the specifications of version IV.

where

$$\sigma_o^i = \frac{2.6038 \times 10^6}{E_i} \quad \frac{A+1}{A}^{\,2} \quad g_i \quad \frac{\Gamma_n^{0,i}\,\Gamma_\gamma^i}{\left(\sqrt{E_i}\,\Gamma_n^{0,i} + \Gamma_\gamma^i\right)^2}$$

At E = 0.253 eV, the first 32 positive levels in ^{232}Th contribute 0.44 barns. Parameters for these levels were takne from Reference 1.

If $\sigma_{n,\gamma}$ (0.0253 eV) = 7.4 ± 0.1 barns

is the preferred experimental value(1), then 6.96 barns must be attributed to the negative energy levels and the remaining positive energy resonances. In this evaluation, the remaining contributions were attributed to a single negative energy level at -7 eV (first negative levels would be expected at approximately -2 and -14 eV). With $\Gamma_n^o = 0.0321 \times 10^{-2}$(eV) and $\Gamma_\gamma = 0.0259$ eV, this fiducial level contributes 6.96 barns to the 2200 m/sec capture cross section, and, this model therefore, will produce the preferred value of $\sigma_{n\gamma}$(0.0253 eV) for ^{232}Th.

The Resolved Resonance Energy Region (10 eV to 3.94 keV)

From 10 eV to 3.006 keV, parameters for the resolved resonances in ^{232}Th are the recommended values given in Reference 1. The remaining parameters (last resolved resonance appears at 3.931 keV) were obtained from measurements reported by Garg, et al.(2) The capture width was taken as constant, Γ_γ = 0.0259 eV. All levels were taken as s-wave (ℓ = 0) levels (none were identified as p-wave or "doubtful"). These parameters were used in the single-level, Breit-Wigner formula.

The Unresolved Resonance Region (3.94 keV to 50 keV)

Unresolved resonance parameters for Th-232 are given in Table 2. The s-wave parameters are identical to those used by Sehgal[3] in his recent study of the thorium resonance integral and were deduced from the resolved resonance data. The p-wave strength function was selected such that calculated, infinitely-dilute, capture cross sections would agree well with experimental values reported in Reference[1]. The calculations were performed with the ERIC-2[4] code and comparison of the calculated and experimental capture cross sections was made over an energy range extending from 10 keV to 200 keV (the unresolved region cut-off, however, was taken at 50 keV). For these calculations, the $\ell = 1$ strength function was assumed constant and independent of J, and the average level spacing assumed proportional to $(2J + 1)^{-1}$; the mean reduced neutron width can then be computed from

$$\bar{\Gamma}_n^0 (E) = S_\ell \bar{D}_{\ell,j} \quad E \quad \nu_\ell$$

where

S_1 = strength function

ν_ℓ = penetration factor

= 1 for $\ell = 0$

= $\frac{x^2}{1+x^2}$ for $\ell = 1$; $x = 0.00191\sqrt{E}$

The neutron level widths were assumed to be distributed in a chi-squared distribution with one degree of freedom ($\nu = 1$). For $S_1 = 1.20 \times 10^{-4}$, the calculated and measured cross sections are in good agreement; sources for the measured data are given in Reference 1. The Harwell data is given greater weight than that of Sehgal(3), resulting in a lower p-wave strength function. The ERIC-2 calculations utilized 100 "narrow" groups and a potential scattering cross section of 12.0 barns.

Table 2

Unresolved Resonance Parameters for ^{232}Th

	$\ell = 0$	$\ell = 1$	
	J = 1/2	J = 1/2	J = 3/2
$\bar{D}$	12.95 ev	12.95	1.475
S_ℓ	0.73×10^{-4}	1.20×10^{-4}	1.20×10^{-4}
Γ_γ	0.0259 ev	0.0259	0.0259

The Radiative Capture Cross Section (.05-15 MeV)*

From 0.05 MeV to 0.12 MeV a smooth curve is drawn to connect with the value given by the solid line of Reference 1. From 0.12 MeV to 15 MeV the solid line of Reference 1 was used. This gives the (n,γ) cross section tabulated in File 3.

The Fission Cross Section*

The fission cross section up to 10 MeV was taken from the work of Davey[5] who made an evaluation of the fission cross section up to MeV. From 10 MeV to 15 MeV the fission cross section given by the solid line of Reference 1 was used. The fission cross section thus obtained is tabulated in File 3.

References

1. J.R. Stehn, et al., BNL-235, 2nd Ed., Sup. 2, Vol. III (1965).
2. J.B. Garg, J. Rainwater, J.S. Petersen and W.W. Havens, Jr., Phys. Rev. 134, B895 (1964).
3. B.R. Sehgal, Private Communication to D. Roy and A. Livolsi (1966).
4. H.M. Sumner, AEEW-R-323, (April 1964).
5. W.G. Davey, Nuc. Sci. Engr, 26, 149 (1966).

*The cross sections were extrapolated to 20 MeV at the NNCSC.

ENDF/B MATERIAL NO. 6296

THORIUM-232

RESONANCE DATA
RESONANCE PARAMETERS

ISOTOPE--------------------THORIUM-232
FRACTIONAL ABUNDANCE--------- 1.0000E+00
NUMBER OF ENERGY RANGES------ 2

ENERGY RANGE NUMBER---------- 1
LOWER ENERGY LIMIT (EV)------ 1.0000E+01
UPPER ENERGY LIMIT (EV)------ 3.9400E+03
NUCLEAR SPIN----------------- 0.0000E+00
SPIN SCATTERING LENGTH (A+)-- 8.9874E-01
NUMBER OF L STATES----------- 1

RESOLVED SINGLE-LEVEL BREIT-WIGNER PARAMETERS

L VALUE---------------------- 0
NUMBER OF RESONANCES--------- 229
SPIN SCATTERING LENGTH (A-)-= 0.0000E+00

INDEX	ENERGY (EV)	J VALUE	RESONANCE WIDTHS (EV) TOTAL	NEUTRON	RADIATION	FISSION
1	-5.1000E+00	5.0000E-01	2.8204E-02	4.2040E-03	2.4000E-02	0.0000E+00
2	8.3400E+00	5.0000E-01	2.5900E-02	2.5000E-07	2.5900E-02	0.0000E+00
3	1.3110E+01	5.0000E-01	2.5900E-02	2.0000E-07	2.5900E-02	0.0000E+00
4	2.1780E+01	5.0000E-01	2.7900E-02	2.0000E-03	2.5900E-02	0.0000E+00
5	2.3450E+01	5.0000E-01	2.9640E-02	3.7400E-03	2.5900E-02	0.0000E+00
6	3.6900E+01	5.0000E-01	2.5901E-02	1.0500E-06	2.5900E-02	0.0000E+00
7	3.8200E+01	5.0000E-01	2.5901E-02	6.3000E-07	2.5900E-02	0.0000E+00
8	4.1000E+01	5.0000E-01	2.5901E-02	5.9000E-07	2.5900E-02	0.0000E+00
9	4.7100E+01	5.0000E-01	2.5902E-02	1.7000E-06	2.5900E-02	0.0000E+00
10	5.9460E+01	5.0000E-01	2.9900E-02	4.0000E-03	2.5900E-02	0.0000E+00
11	6.9130E+01	5.0000E-01	6.7900E-02	4.2000E-02	2.5900E-02	0.0000E+00
12	9.0100E+01	5.0000E-01	2.5905E-02	5.0000E-06	2.5900E-02	0.0000E+00
13	9.8000E+01	5.0000E-01	2.5904E-02	4.0000E-06	2.5900E-02	0.0000E+00
14	1.0360E+02	5.0000E-01	2.5906E-02	6.0000E-06	2.5900E-02	0.0000E+00
15	1.1287E+02	5.0000E-01	3.8300E-02	1.2400E-02	2.5900E-02	0.0000E+00
16	1.2075E+02	5.0000E-01	4.6400E-02	2.0500E-02	2.5900E-02	0.0000E+00
17	1.2810E+02	5.0000E-01	2.5980E-02	8.0000E-05	2.5900E-02	0.0000E+00
18	1.2910E+02	5.0000E-01	2.9400E-02	3.5000E-03	2.5900E-02	0.0000E+00
19	1.4590E+02	5.0000E-01	2.5960E-02	6.0000E-05	2.5900E-02	0.0000E+00
20	1.5437E+02	5.0000E-01	2.6020E-02	1.2000E-04	2.5900E-02	0.0000E+00
21	1.7020E+02	5.0000E-01	8.5900E-02	6.0000E-02	2.5900E-02	0.0000E+00
22	1.9260E+02	5.0000E-01	4.0900E-02	1.5000E-02	2.5900E-02	0.0000E+00
23	1.9620E+02	5.0000E-01	2.6230E-02	3.3000E-04	2.5900E-02	0.0000E+00
24	1.9930E+02	5.0000E-01	3.6900E-02	1.1000E-02	2.5900E-02	0.0000E+00
25	2.2110E+02	5.0000E-01	5.5400E-02	2.9500E-02	2.5900E-02	0.0000E+00
26	2.5140E+02	5.0000E-01	5.6900E-02	3.1000E-02	2.5900E-02	0.0000E+00
27	2.6310E+02	5.0000E-01	4.6600E-02	2.0700E-02	2.5900E-02	0.0000E+00
28	2.8570E+02	5.0000E-01	5.5100E-02	2.9200E-02	2.5900E-02	0.0000E+00
29	3.0540E+02	5.0000E-01	5.2900E-02	2.7000E-02	2.5900E-02	0.0000E+00
30	3.2890E+02	5.0000E-01	9.7900E-02	7.2000E-02	2.5900E-02	0.0000E+00
31	3.4180E+02	5.0000E-01	6.3400E-02	3.7500E-02	2.5900E-02	0.0000E+00
32	3.6510E+02	5.0000E-01	5.1900E-02	2.6000E-02	2.5900E-02	0.0000E+00
33	3.6930E+02	5.0000E-01	5.1900E-02	2.6000E-02	2.5900E-02	0.0000E+00
34	4.0090E+02	5.0000E-01	3.6700E-02	1.0800E-02	2.5900E-02	0.0000E+00
35	4.2080E+02	5.0000E-01	2.6300E-02	4.0000E-04	2.5900E-02	0.0000E+00
36	4.5430E+02	5.0000E-01	2.7100E-02	1.2000E-03	2.5900E-02	0.0000E+00
37	4.6250E+02	5.0000E-01	8.7900E-02	6.2000E-02	2.5900E-02	0.0000E+00
38	4.8870E+02	5.0000E-01	8.3900E-02	5.8000E-02	2.5900E-02	0.0000E+00
39	5.1050E+02	5.0000E-01	3.0200E-02	4.3000E-03	2.5900E-02	0.0000E+00
40	5.2850E+02	5.0000E-01	4.0400E-02	1.4500E-02	2.5900E-02	0.0000E+00
41	5.4010E+02	5.0000E-01	2.5980E-02	8.0000E-05	2.5900E-02	0.0000E+00
42	5.6980E+02	5.0000E-01	5.1900E-02	2.6000E-02	2.5900E-02	0.0000E+00
43	5.7820E+02	5.0000E-01	2.8300E-02	2.4000E-03	2.5900E-02	0.0000E+00
44	5.9820E+02	5.0000E-01	3.5400E-02	9.5000E-03	2.5900E-02	0.0000E+00
45	6.1790E+02	5.0000E-01	3.0200E-02	4.3000E-03	2.5900E-02	0.0000E+00
46	6.5670E+02	5.0000E-01	7.0900E-02	4.5000E-02	2.5900E-02	0.0000E+00
47	6.6520E+02	5.0000E-01	4.6900E-02	2.1000E-02	2.5900E-02	0.0000E+00
48	6.7520E+02	5.0000E-01	2.2790E-01	2.0200E-01	2.5900E-02	0.0000E+00
49	6.8730E+02	5.0000E-01	8.4900E-02	5.9000E-02	2.5900E-02	0.0000E+00
50	7.0110E+02	5.0000E-01	3.8900E-02	1.3000E-02	2.5900E-02	0.0000E+00
51	7.1290E+02	5.0000E-01	5.5900E-02	3.0000E-02	2.5900E-02	0.0000E+00
52	7.4090E+02	5.0000E-01	2.2590E-01	2.0000E-01	2.5900E-02	0.0000E+00
53	7.7870E+02	5.0000E-01	3.7200E-02	1.1300E-02	2.5900E-02	0.0000E+00
54	8.0430E+02	5.0000E-01	2.1090E-01	1.8500E-01	2.5900E-02	0.0000E+00
55	8.2130E+02	5.0000E-01	2.6900E-02	1.0000E-03	2.5900E-02	0.0000E+00
56	8.4250E+02	5.0000E-01	5.2900E-02	2.7000E-02	2.5900E-02	0.0000E+00
57	8.5080E+02	5.0000E-01	2.6800E-02	9.0000E-04	2.5900E-02	0.0000E+00
58	8.6650E+02	5.0000E-01	3.9400E-02	1.3500E-02	2.5900E-02	0.0000E+00
59	8.9020E+02	5.0000E-01	5.9900E-02	3.4000E-02	2.5900E-02	0.0000E+00
60	9.0650E+02	5.0000E-01	2.8000E-02	2.1000E-03	2.5900E-02	0.0000E+00
61	9.4340E+02	5.0000E-01	6.7900E-02	4.2000E-02	2.5900E-02	0.0000E+00
62	9.6280E+02	5.0000E-01	3.2100E-02	6.2000E-03	2.5900E-02	0.0000E+00
63	9.8290E+02	5.0000E-01	5.6900E-02	3.1000E-02	2.5900E-02	0.0000E+00
64	9.9050E+02	5.0000E-01	1.0590E-01	8.0000E-02	2.5900E-02	0.0000E+00
65	1.0105E+03	5.0000E-01	1.4590E-01	1.2000E-01	2.5900E-02	0.0000E+00
66	1.0393E+03	5.0000E-01	3.6900E-02	1.1000E-02	2.5900E-02	0.0000E+00
67	1.0650E+03	5.0000E-01	3.0900E-02	5.0000E-03	2.5900E-02	0.0000E+00
68	1.0772E+03	5.0000E-01	3.4900E-02	9.0000E-03	2.5900E-02	0.0000E+00
69	1.0930E+03	5.0000E-01	2.8500E-02	2.6000E-03	2.5900E-02	0.0000E+00

70	1,1100E+03	5,0000E-01	4,8900E-02	2,3000E-02	2,5900E-02	0,0000E+00
71	1,1145E+03	5,0000E-01	2.8600E-02	2.7000E-03	2,5900E-02	0,0000E+00
72	1,1205E+03	5,0000E-01	2,9210E-02	3,3100E-03	2,5900E-02	0,0000E+00
73	1,1390E+03	5,0000E-01	3,9900E-02	1.4000E-02	2,5900E-02	0,0000E+00
74	1,1506E+03	5,0000E-01	4,5900E-02	2,0000E-02	2,5900E-02	0,0000E+00
75	1,1943E+03	5,0000E-01	3.1800E-02	5,9000E-03	2,5900E-02	0,0000E+00
76	1,2044E+03	5,0000E-01	2,7300E-02	1,4000E-03	2,5900E-02	0,0000E+00
77	1,2270E+03	5,0000E-01	5,0900E-02	2,5000E-02	2,5900E-02	0,0000E+00
78	1,2431E+03	5,0000E-01	4,1400E-02	1,5500E-02	2,5900E-02	0,0000E+00
79	1,2487E+03	5,0000E-01	1,1590E-01	9,0000E-02	2,5900E-02	0,0000E+00
80	1,2695E+03	5,0000E-01	4,4900E-02	1,9000E-02	2,5900E-02	0,0000E+00
81	1,2921E+03	5,0000E-01	9,0900E-02	6,5000E-02	2,5900E-02	0,0000E+00
82	1,3016E+03	5,0000E-01	6,3900E-02	3,8000E-02	2,5900E-02	0,0000E+00
83	1,3347E+03	5,0000E-01	2,8823E-02	2,9227E-03	2,5900E-02	0,0000E+00
84	1,3456E+03	5,0000E-01	2,6744E-02	8,4370E-04	2,5900E-02	0,0000E+00
85	1,3540E+03	5,0000E-01	9,2154E-02	6,6254E-02	2,5900E-02	0,0000E+00
86	1,3599E+03	5,0000E-01	3,0325E-02	4,4252E-03	2,5900E-02	0,0000E+00
87	1,3779E+03	5,0000E-01	6,4876E-02	3,8976E-02	2,5900E-02	0,0000E+00
88	1,3871E+03	5,0000E-01	2,8135E-02	2,2346E-03	2,5900E-02	0,0000E+00
89	1,3977E+03	5,0000E-01	1,1936E-01	9,3465E-02	2,5900E-02	0,0000E+00
90	1,4173E+03	5,0000E-01	2,6578E-02	6,7765E-04	2,5900E-02	0,0000E+00
91	1,4266E+03	5,0000E-01	1,0144E-01	7,5541E-02	2,5900E-02	0,0000E+00
92	1,4337E+03	5,0000E-01	5,8842E-02	3,2942E-02	2,5900E-02	0,0000E+00
93	1,5092E+03	5,0000E-01	2,8619E-02	2,7194E-03	2,5900E-02	0,0000E+00
94	1,5184E+03	5,0000E-01	1,5839E-01	1,3249E-01	2,5900E-02	0,0000E+00
95	1,5241E+03	5,0000E-01	1,5864E-01	1,3274E-01	2,5900E-02	0,0000E+00
96	1,5554E+03	5,0000E-01	3,2210E-02	6,3102E-03	2,5900E-02	0,0000E+00
97	1,5810E+03	5,0000E-01	3,8624E-02	1,2724E-02	2,5900E-02	0,0000E+00
98	1,5891E+03	5,0000E-01	2,8501E-01	2,5911E-01	2,5900E-02	0,0000E+00
99	1,6027E+03	5,0000E-01	6,9937E-02	4,4037E-02	2,5900E-02	0,0000E+00
100	1,6306E+03	5,0000E-01	3,8933E-01	3,6343E-01	2,5900E-02	0,0000E+00
101	1,6406E+03	5,0000E-01	6,4379E-02	3,8479E-02	2,5900E-02	0,0000E+00
102	1,6610E+03	5,0000E-01	1,1964E-01	9,3737E-02	2,5900E-02	0,0000E+00
103	1,6778E+03	5,0000E-01	4,4332E-02	1,8432E-02	2,5900E-02	0,0000E+00
104	1,7052E+03	5,0000E-01	2,9616E-02	3,7165E-03	2,5900E-02	0,0000E+00
105	1,7197E+03	5,0000E-01	5,5758E-02	2,9858E-02	2,5900E-02	0,0000E+00
106	1,7290E+03	5,0000E-01	2,7439E-02	1,5385E-03	2,5900E-02	0,0000E+00
107	1,7399E+03	5,0000E-01	3,2157E-02	6,2568E-03	2,5900E-02	0,0000E+00
108	1,7465E+03	5,0000E-01	5,2646E-02	2,6746E-02	2,5900E-02	0,0000E+00
109	1,7627E+03	5,0000E-01	1,0567E-01	7,9771E-02	2,5900E-02	0,0000E+00
110	1,8032E+03	5,0000E-01	9,3843E-02	6,7943E-02	2,5900E-02	0,0000E+00
111	1,8118E+03	5,0000E-01	6,2080E-02	3,6180E-02	2,5900E-02	0,0000E+00
112	1,8244E+03	5,0000E-01	9,4241E-02	6,8341E-02	2,5900E-02	0,0000E+00
113	1,8481E+03	5,0000E-01	2,8479E-02	2,5794E-03	2,5900E-02	0,0000E+00
114	1,8539E+03	5,0000E-01	6,0346E-02	3,4446E-02	2,5900E-02	0,0000E+00
115	1,8615E+03	5,0000E-01	5,3513E-02	2,7613E-02	2,5900E-02	0,0000E+00
116	1,9008E+03	5,0000E-01	1,1310E-01	8,7196E-02	2,5900E-02	0,0000E+00
117	1,9302E+03	5,0000E-01	4,3913E-02	1,8013E-02	2,5900E-02	0,0000E+00
118	1,9512E+03	5,0000E-01	1,0541E-01	7,9510E-02	2,5900E-02	0,0000E+00
119	1,9712E+03	5,0000E-01	1,9017E-01	1,6427E-01	2,5900E-02	0,0000E+00
120	1,9882E+03	5,0000E-01	6,1571E-02	3,5671E-02	2,5900E-02	0,0000E+00
121	2,0052E+03	5,0000E-01	1,1546E-01	8,9559E-02	2,5900E-02	0,0000E+00
122	2,0347E+03	5,0000E-01	2,8606E-02	2,7065E-03	2,5900E-02	0,0000E+00
123	2,0516E+03	5,0000E-01	4,2659E-02	1,6759E-02	2,5900E-02	0,0000E+00
124	2,0617E+03	5,0000E-01	7,1306E-02	4,5406E-02	2,5900E-02	0,0000E+00
125	2,0739E+03	5,0000E-01	3,1365E-02	5,4648E-03	2,5900E-02	0,0000E+00
126	2,0789E+03	5,0000E-01	3,9578E-02	1,3678E-02	2,5900E-02	0,0000E+00
127	2,1167E+03	5,0000E-01	9,9512E-02	7,3612E-02	2,5900E-02	0,0000E+00
128	2,1474E+03	5,0000E-01	9,0776E-02	6,4876E-02	2,5900E-02	0,0000E+00
129	2,1624E+03	5,0000E-01	1,0960E-01	8,3703E-02	2,5900E-02	0,0000E+00
130	2,1783E+03	5,0000E-01	7,7239E-02	5,1339E-02	2,5900E-02	0,0000E+00
131	2,1970E+03	5,0000E-01	7,2772E-02	4,6872E-02	2,5900E-02	0,0000E+00
132	2,2159E+03	5,0000E-01	3,2961E-02	7,0610E-03	2,5900E-02	0,0000E+00
133	2,2222E+03	5,0000E-01	8,2468E-02	5,6568E-02	2,5900E-02	0,0000E+00
134	2,2703E+03	5,0000E-01	3,4953E-02	9,0531E-03	2,5900E-02	0,0000E+00
135	2,2762E+03	5,0000E-01	5,4526E-02	2,8626E-02	2,5900E-02	0,0000E+00
136	2,2867E+03	5,0000E-01	2,4587E-01	2,1997E-01	2,5900E-02	0,0000E+00
137	2,3212E+03	5,0000E-01	3,1200E-02	5,2997E-03	2,5900E-02	0,0000E+00
138	2,3361E+03	5,0000E-01	1,1290E-01	8,7000E-02	2,5900E-02	0,0000E+00
139	2,3526E+03	5,0000E-01	5,2577E-02	2,6677E-02	2,5900E-02	0,0000E+00
140	2,3619E+03	5,0000E-01	3,0760E-02	4,8599E-03	2,5900E-02	0,0000E+00
141	2,3748E+03	5,0000E-01	1,0387E-01	7,7971E-02	2,5900E-02	0,0000E+00
142	2,3818E+03	5,0000E-01	3,2733E-02	6,8325E-03	2,5900E-02	0,0000E+00
143	2,3904E+03	5,0000E-01	2,8834E-02	2,9335E-03	2,5900E-02	0,0000E+00
144	2,4184E+03	5,0000E-01	9,4748E-02	6,8848E-02	2,5900E-02	0,0000E+00
145	2,4399E+03	5,0000E-01	3,1333E-02	5,4335E-03	2,5900E-02	0,0000E+00
146	2,4561E+03	5,0000E-01	1,6962E-01	1,4372E-01	2,5900E-02	0,0000E+00
147	2,4917E+03	5,0000E-01	3,0892E-02	4,9917E-03	2,5900E-02	0,0000E+00
148	2,5087E+03	5,0000E-01	2,7633E-01	2,5043E-01	2,5900E-02	0,0000E+00
149	2,5265E+03	5,0000E-01	7,1138E-02	4,5238E-02	2,5900E-02	0,0000E+00
150	2,5630E+03	5,0000E-01	2,2840E-01	2,0250E-01	2,5900E-02	0,0000E+00
151	2,5691E+03	5,0000E-01	6,1380E-02	3,5480E-02	2,5900E-02	0,0000E+00
152	2,6117E+03	5,0000E-01	1,5366E-01	1,2776E-01	2,5900E-02	0,0000E+00
153	2,6233E+03	5,0000E-01	3,2046E-02	6,1462E-03	2,5900E-02	0,0000E+00
154	2,6342E+03	5,0000E-01	2,8252E-01	2,5662E-01	2,5900E-02	0,0000E+00
155	2,6540E+03	5,0000E-01	2,8476E-02	2,5758E-03	2,5900E-02	0,0000E+00
156	2,6642E+03	5,0000E-01	3,3560E-01	3,0970E-01	2,5900E-02	0,0000E+00
157	2,6773E+03	5,0000E-01	3,5214E-02	9,3137E-03	2,5900E-02	0,0000E+00
158	2,6881E+03	5,0000E-01	1,0367E-01	7,7770E-02	2,5900E-02	0,0000E+00
159	2,7126E+03	5,0000E-01	1,5611E-01	1,3021E-01	2,5900E-02	0,0000E+00
160	2,7218E+03	5,0000E-01	3,3204E-02	7,3039E-03	2,5900E-02	0,0000E+00
161	2,7332E+03	5,0000E-01	2,8730E-01	2.6140E-01	2,5900E-02	0,0000E+00

162	2,7474E+03	5,0000E-01	3,4811E-02	8,9107E-03	2,5900E-02	0,0000E+00
163	2,7631E+03	5,0000E-01	2,8528E-02	2.6283E-03	2,5900E-02	0,0000E+00
164	2,7730E+03	5,0000E-01	7,8559E-02	5.2659E-02	2,5900E-02	0,0000E+00
165	2,7925E+03	5,0000E-01	1,4216E-01	1.1626E-01	2,5900E-02	0,0000E+00
166	2,8154E+03	5,0000E-01	4,7124E-02	2.1224E-02	2,5900E-02	0,0000E+00
167	2,8327E+03	5,0000E-01	5,2512E-02	2,6612E-02	2,5900E-02	0,0000E+00
168	2,8527E+03	5,0000E-01	1,7545E-01	1.4955E-01	2,5900E-02	0,0000E+00
169	2,8828E+03	5,0000E-01	3,6638E-02	1,0738E-02	2,5900E-02	0,0000E+00
170	2,8949E+03	5,0000E-01	3,4509E-02	8,6087E-03	2,5900E-02	0,0000E+00
171	2,9140E+03	5,0000E-01	3,3457E-02	7.5574E-03	2,5900E-02	0,0000E+00
172	2,9472E+03	5,0000E-01	1,0190E-01	7,6003E-02	2,5900E-02	0,0000E+00
173	2,9559E+03	5,0000E-01	5,4715E-02	2,8815E-02	2,5900E-02	0,0000E+00
174	2,9651E+03	5,0000E-01	4,2236E-02	1,6336E-02	2,5900E-02	0,0000E+00
175	2,9781E+03	5,0000E-01	3,5723E-02	9,8230E-03	2,5900E-02	0,0000E+00
176	2,9888E+03	5,0000E-01	5,4328E-02	2,8428E-02	2,5900E-02	0,0000E+00
177	3,0060E+03	5,0000E-01	3,3028E-02	7.1275E-03	2,5900E-02	0,0000E+00
178	3,0164E+03	5,0000E-01	4,9516E-02	2,3616E-02	2,5900E-02	0,0000E+00
179	3,0278E+03	5,0000E-01	1,9923E-01	1,7333E-01	2,5900E-02	0,0000E+00
180	3,0393E+03	5,0000E-01	6,4491E-02	3,8591E-02	2,5900E-02	0,0000E+00
181	3,0497E+03	5,0000E-01	3,5840E-02	9,9403E-03	2,5900E-02	0,0000E+00
182	3,0601E+03	5,0000E-01	5,6325E-02	3,0425E-02	2,5900E-02	0,0000E+00
183	3,0811E+03	5,0000E-01	7,3082E-02	4,7182E-02	2,5900E-02	0,0000E+00
184	3,1024E+03	5,0000E-01	2,8685E-02	2.7850E-03	2,5900E-02	0,0000E+00
185	3,1094E+03	5,0000E-01	5,9357E-02	3.3457E-02	2,5900E-02	0,0000E+00
186	3,1479E+03	5,0000E-01	3,6254E-01	3.3664E-01	2,5900E-02	0,0000E+00
187	3,1528E+03	5,0000E-01	3,9087E-01	3,6497E-01	2,5900E-02	0,0000E+00
188	3,1638E+03	5,0000E-01	4,3899E-02	1.7999E-02	2,5900E-02	0,0000E+00
189	3,1871E+03	5,0000E-01	9,6468E-02	7,0568E-02	2,5900E-02	0,0000E+00
190	3,2070E+03	5,0000E-01	1,2783E-01	1.0193E-01	2,5900E-02	0,0000E+00
191	3,2295E+03	5,0000E-01	3,7266E-02	1.1366E-02	2,5900E-02	0,0000E+00
192	3,2421E+03	5,0000E-01	3,7288E-02	1.1388E-02	2,5900E-02	0,0000E+00
193	3,2523E+03	5,0000E-01	8,8632E-02	6,2732E-02	2,5900E-02	0,0000E+00
194	3,2676E+03	5,0000E-01	6,0198E-02	3,4298E-02	2,5900E-02	0,0000E+00
195	3,2960E+03	5,0000E-01	3,7037E-01	3,4447E-01	2,5900E-02	0,0000E+00
196	3,3169E+03	5,0000E-01	2,8780E-02	2.8796E-03	2,5900E-02	0,0000E+00
197	3,3301E+03	5,0000E-01	8,3607E-02	5.7707E-02	2,5900E-02	0,0000E+00
198	3,3406E+03	5,0000E-01	1,7040E-01	1.4450E-01	2,5900E-02	0,0000E+00
199	3,3714E+03	5,0000E-01	2,8803E-02	2.9032E-03	2,5900E-02	0,0000E+00
200	3,3835E+03	5,0000E-01	1,2769E-01	1.0179E-01	2,5900E-02	0,0000E+00
201	3,4107E+03	5,0000E-01	5,5100E-02	2.9200E-02	2,5900E-02	0,0000E+00
202	3,4216E+03	5,0000E-01	3,4674E-02	8,7742E-03	2,5900E-02	0,0000E+00
203	3,4286E+03	5,0000E-01	6,7474E-02	4,1574E-02	2,5900E-02	0,0000E+00
204	3,4437E+03	5,0000E-01	7,2847E-02	4,6947E-02	2,5900E-02	0,0000E+00
205	3,4716E+03	5,0000E-01	5.5360E-02	2,9460E-02	2,5900E-02	0,0000E+00
206	3,4914E+03	5,0000E-01	3,7718E-02	1.1818E-02	2,5900E-02	0,0000E+00
207	3,5199E+03	5,0000E-01	1,2972E-01	1,0382E-01	2,5900E-02	0,0000E+00
208	3,5662E+03	5,0000E-01	2,8289E-02	2,3887E-03	2,5900E-02	0,0000E+00
209	3,5750E+03	5,0000E-01	3,7858E-02	1.1958E-02	2,5900E-02	0,0000E+00
210	3,5927E+03	5,0000E-01	4,7478E-02	2.1578E-02	2,5900E-02	0,0000E+00
211	3,6105E+03	5,0000E-01	1,0702E-01	8,1118E-02	2,5900E-02	0,0000E+00
212	3,6224E+03	5,0000E-01	5,5993E-02	3,0093E-02	2,5900E-02	0,0000E+00
213	3,6374E+03	5,0000E-01	4,3993E-02	1.8093E-02	2,5900E-02	0,0000E+00
214	3,6495E+03	5,0000E-01	8,6311E-02	6,0411E-02	2,5900E-02	0,0000E+00
215	3,6738E+03	5,0000E-01	4,5296E-02	1.9396E-02	2,5900E-02	0,0000E+00
216	3,6922E+03	5,0000E-01	5,6282E-02	3,0382E-02	2,5900E-02	0,0000E+00
217	3,7070E+03	5,0000E-01	5,5125E-02	2,9225E-02	2,5900E-02	0,0000E+00
218	3,7232E+03	5,0000E-01	2,6997E-01	2,4407E-01	2,5900E-02	0,0000E+00
219	3,7326E+03	5,0000E-01	8,6995E-02	6,1095E-02	2,5900E-02	0,0000E+00
220	3,7450E+03	5,0000E-01	4,1811E-02	1,5911E-02	2,5900E-02	0,0000E+00
221	3,7576E+03	5,0000E-01	4,4290E-02	1,8390E-02	2,5900E-02	0,0000E+00
222	3,7864E+03	5,0000E-01	5,0514E-02	2.4614E-02	2,5900E-02	0,0000E+00
223	3,8186E+03	5,0000E-01	4,3203E-02	1,7303E-02	2,5900E-02	0,0000E+00
224	3,8251E+03	5,0000E-01	2,4237E-01	2,1647E-01	2,5900E-02	0,0000E+00
225	3,8479E+03	5,0000E-01	5,0713E-02	2,4813E-02	2,5900E-02	0,0000E+00
226	3,8677E+03	5,0000E-01	6,6324E-02	4,0424E-02	2,5900E-02	0,0000E+00
227	3,8842E+03	5,0000E-01	4,4597E-02	1,8697E-02	2,5900E-02	0,0000E+00
228	3,9043E+03	5,0000E-01	2,7584E-01	2,4994E-01	2,5900E-02	0,0000E+00
229	3,9312E+03	5,0000E-01	1,0804E-01	8,2136E-02	2,5900E-02	0,0000E+00

ENDF/B MATERIAL NO. 6296

THORIUM-232

RESONANCE DATA
RESONANCE PARAMETERS

ISOTOPE-------------------------THORIUM-232
FRACTIONAL ABUNDANCE----------- 1.0000E+00
NUMBER OF ENERGY RANGES------ 2

ENERGY RANGE NUMBER---------- 2 UNRESOLVED SINGLE-LEVEL BREIT-WIGNER PARAMETERS
LOWER ENERGY LIMIT (EV)------ 3.9400E+03
UPPER ENERGY LIMIT (EV)------ 5.0000E+04
NUCLEAR SPIN----------------- 0.0000E+00
EFFECTIVE SCATTERING RADIUS-- 8.9874E-01
NUMBER OF L STATES----------- 2

L VALUE---------------------- 0
NUMBER OF J STATES----------- 1

LEVEL SPACING	J-VALUE	DEG OF FREEDOM	AVERAGE RESONANCE WIDTHS (EV) NEUTRON	RADIATION
1.7000E+01	5.0000E-01	1.0000E+00	1.2417E-03	2.5900E-02

L VALUE---------------------- 1
NUMBER OF J STATES----------- 2

LEVEL SPACING	J-VALUE	DEG OF FREEDOM	AVERAGE RESONANCE WIDTHS (EV) NEUTRON	RADIATION
1.7000E+01	5.0000E-01	1.0000E+00	2.0400E-03	2.5900E-02
8.5000E+00	1.5000E+00	1.0000E+00	1.2000E-03	2.5900E-02

THORIUM-232

FISSION
NEUTRON CROSS SECTION

ENDF/B MATERIAL NO. 6296

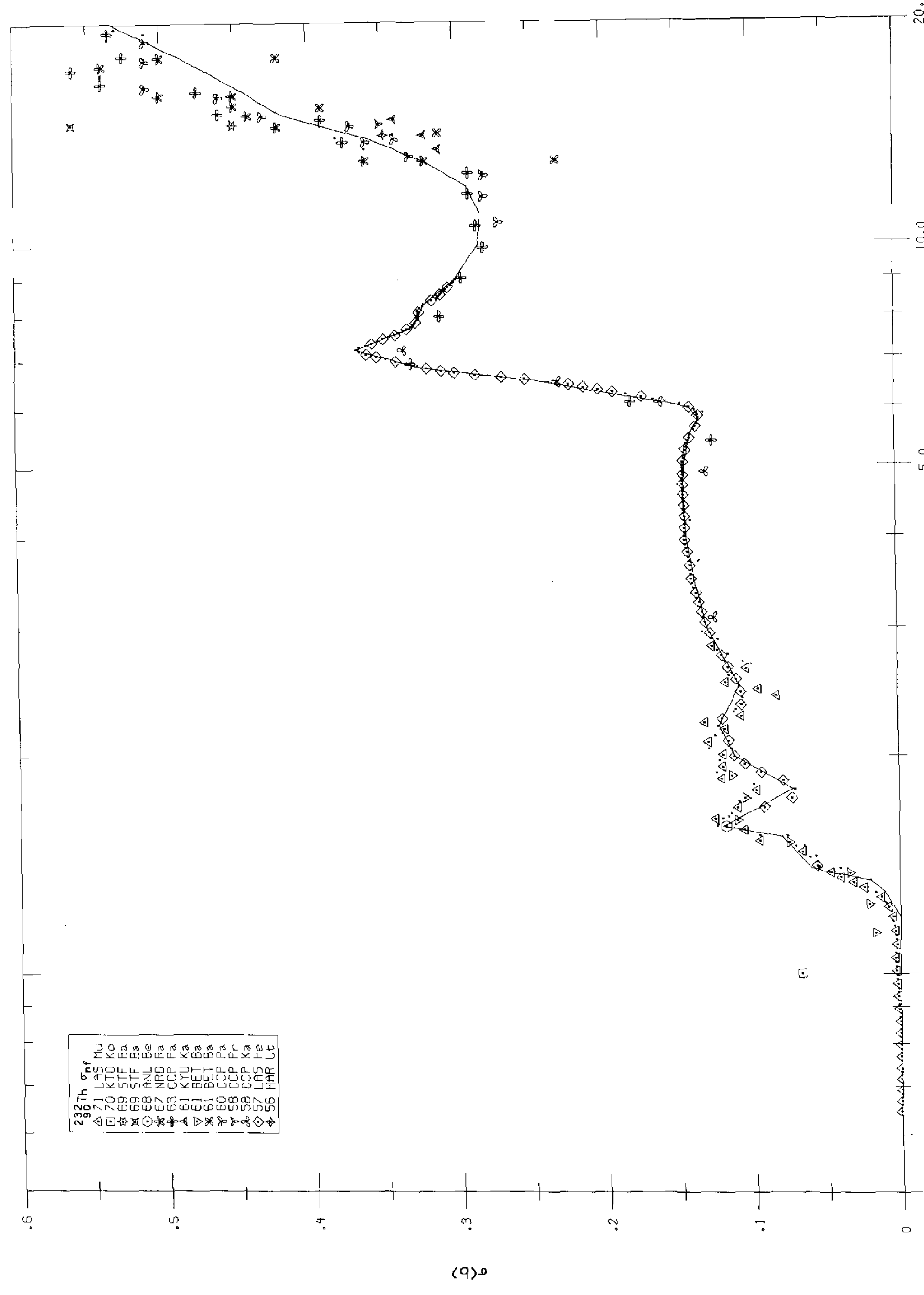
REACTION Q VALUE 1.6440E+08 EV

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION
1 TO 32	Y LINEAR IN X

NEUTRON CROSS SECTIONS

INDEX,	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	1.2000E+06	0.0000E+00	1.3000E+06	1.0000E-02	1.3500E+06	2.0000E-02	1.4000E+06	6.0000E-02	1.5500E+06	8.0000E-02
6	1.6000E+06	1.2000E-01	1.8000E+06	7.2000E-02	2.0000E+06	1.1200E-01	2.2000E+06	1.2200E-01	2.5000E+06	1.0800E-01
11	3.0000E+06	1.3000E-01	3.5000E+06	1.3800E-01	4.0000E+06	1.4300E-01	4.5000E+06	1.4500E-01	5.0000E+06	1.4400E-01
16	5.5000E+06	1.4000E-01	5.8000E+06	1.3400E-01	6.0000E+06	1.4000E-01	6.5000E+06	2.4000E-01	6.8000E+06	3.2000E-01
21	7.2000E+06	3.6800E-01	7.7000E+06	3.3000E-01	8.0000E+06	3.2400E-01	8.3000E+06	3.2000E-01	9.0000E+06	2.9800E-01
26	1.0000E+07	2.8300E-01	1.1000E+07	2.8200E-01	1.2000E+07	2.9100E-01	1.3000E+07	3.2000E-01	1.4000E+07	3.6000E-01
31	1.5000E+07	4.1500E-01	2.0000E+07	5.3203E-01						



232/90 Th σnf
71 LAS Mu
70 KTO Ko
69 STF Ba
69 STF Ba
68 ANL Be
67 NRD Ra
63 CCP Pa
61 KYU Ka
61 BET Ba
61 BET Ba
60 CCP Pa
58 CCP Pr
58 CCP Ka
57 LAS He
56 HAR Ut
En(MeV)
σ(b)

REFERENCES FOR EXPERIMENTAL DATA

^{232}Th(n,f)

YR.	Lab	Author	References
71	LAS	Muir, et al.	Third Conf. Neutron Cross Sections and Tech., Knoxville Tenn. Vol I, 292 (1971)
70	KTO	Kobayashi, et al.	EANDC-(J)-19, 37 (1970)
69	STF	Barrall, et al.	AFWL-TR-68-134 (1969)
68	ANL	Behkami, et al.	Nuc. Phys./A 118, 65 (1968)
67	NRD	Rago, et al.	Health Phys. 13, 654 (1967)
63	CCP	Pankratov	At. En. 14, 177 (1963)
61	KYU	Katase	Priv. Comm. (1961)
61	BET	Babcock	Priv. Comm. (1961)
60	CCP	Pankratov, er al.	At. En. 9, 399 (1960)
58	CCP	Protopopov, et al.	At. En. 4, 190 (1958)
58	CCP	Kalanin, et al.	Second Peaceful Uses At. En. Conf. Geneva Vol 16, 136 (1958)
57	LAS	Henkel	LA-2122 (1957)
56	HAR	Uttley, et al.	AERE-NP/R-1996 (1956)

REACTION Q VALUE 4.7804E+06 EV

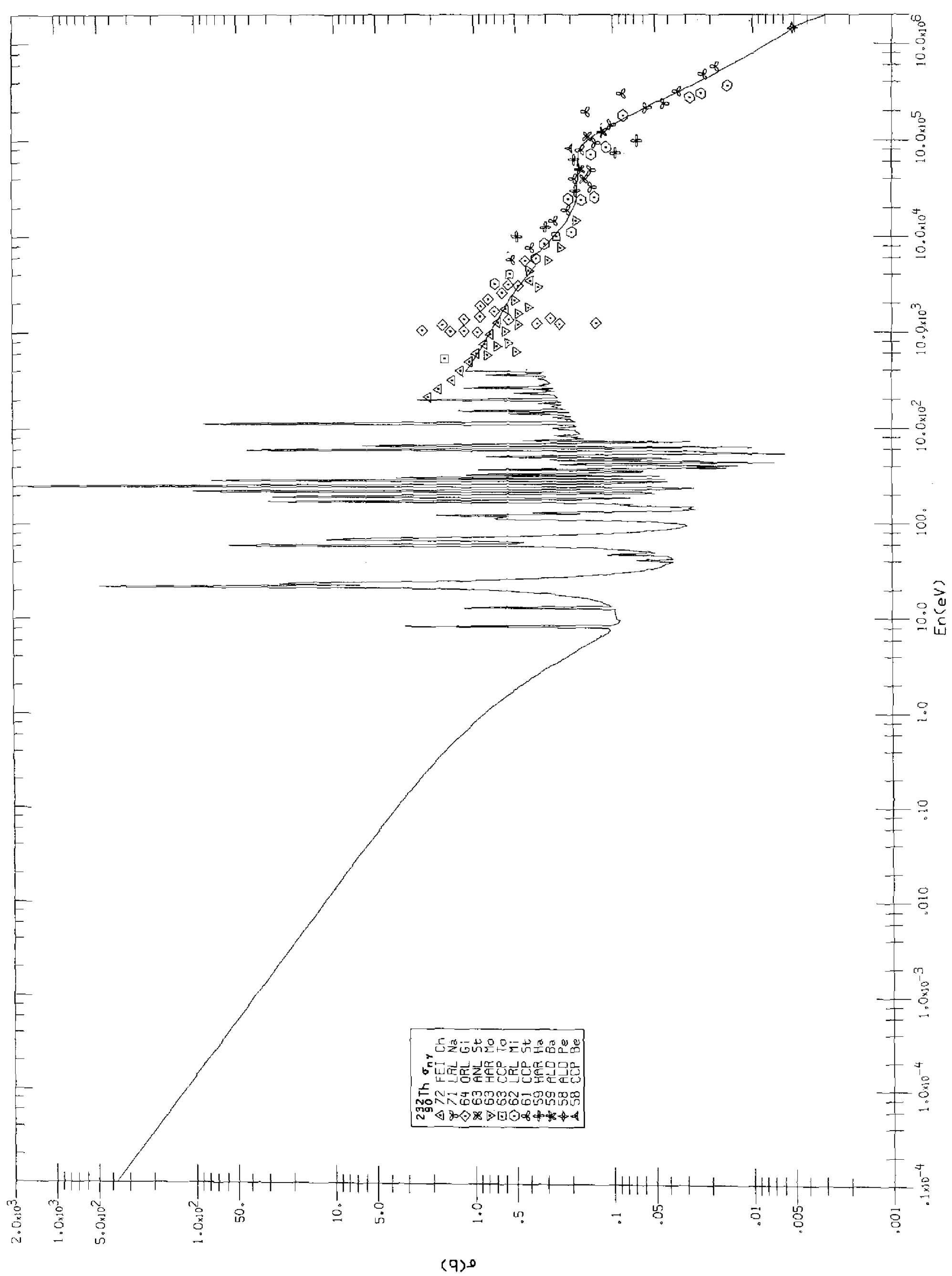
INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION	RANGE	DESCRIPTION	RANGE	DESCRIPTION
1 TO 277	LN Y LINEAR IN LN X	277 TO 299	Y LINEAR IN X	299 TO 332	LN Y LINEAR IN LN X
332 TO 333	Y LINEAR IN X				

NEUTRON CROSS SECTIONS

INDEX,	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	1.0000E-05	3.7570E+02	1.0000E-04	1.1880E+02	1.2002E-04	1.0645E+02	1.4000E-04	1.0040E+02	1.6000E-04	9.3919E+01
6	1.8000E-04	8.8547E+01	2.0000E-04	8.4002E+01	2.2000E-04	8.0092E+01	2.4000E-04	7.6682E+01	2.5300E-04	7.4686E+01
11	2.6000E-04	7.3673E+01	2.8000E-04	7.0993E+01	3.0000E-04	6.8585E+01	3.2000E-04	6.6407E+01	3.4000E-04	6.4424E+01
16	3.6000E-04	6.2608E+01	3.8000E-04	6.0938E+01	4.0000E-04	5.9394E+01	4.2000E-04	5.7962E+01	4.4000E-04	5.6629E+01
21	4.6000E-04	5.5384E+01	4.8000E-04	5.4218E+01	5.0000E-04	5.3122E+01	5.2000E-04	5.2090E+01	5.4000E-04	5.1116E+01
26	5.6000E-04	5.0194E+01	5.8000E-04	4.9321E+01	6.0000E-04	4.8492E+01	6.2000E-04	4.7703E+01	6.4000E-04	4.6951E+01
31	6.6000E-04	4.6234E+01	6.8000E-04	4.5549E+01	7.0000E-04	4.4893E+01	7.2002E-04	4.4265E+01	7.4000E-04	4.3662E+01
36	7.6000E-04	4.3083E+01	7.8000E-04	4.2527E+01	8.0000E-04	4.1992E+01	8.2000E-04	4.1476E+01	8.4000E-04	4.0979E+01
41	8.6000E-04	4.0500E+01	8.8000E-04	4.0036E+01	9.0000E-04	3.9589E+01	9.2000E-04	3.9156E+01	9.4000E-04	3.8737E+01
46	9.6000E-04	3.8331E+01	9.8000E-04	3.7937E+01	1.0000E-03	3.7556E+01	1.2000E-03	3.4281E+01	1.4000E-03	3.1736E+01
51	1.6000E-03	2.9684E+01	1.8000E-03	2.7984E+01	2.0000E-03	2.6546E+01	2.2000E-03	2.5309E+01	2.4000E-03	2.4230E+01
56	2.5300E-03	2.3598E+01	2.6000E-03	2.3277E+01	2.8000E-03	2.2429E+01	3.0000E-03	2.1667E+01	3.2000E-03	2.0977E+01
61	3.4000E-03	2.0349E+01	3.6000E-03	1.9775E+01	3.8000E-03	1.9246E+01	4.0000E-03	1.8757E+01	4.2000E-03	1.8304E+01
66	4.4000E-03	1.7882E+01	4.6000E-03	1.7487E+01	4.8000E-03	1.7118E+01	5.0000E-03	1.6771E+01	5.2000E-03	1.6444E+01
71	5.4000E-03	1.6135E+01	5.6000E-03	1.5843E+01	5.8000E-03	1.5567E+01	6.0000E-03	1.5304E+01	6.2000E-03	1.5054E+01
76	6.4000E-03	1.4816E+01	6.6000E-03	1.4588E+01	6.8000E-03	1.4371E+01	7.0000E-03	1.4163E+01	7.2000E-03	1.3964E+01
81	7.4000E-03	1.3773E+01	7.6000E-03	1.3590E+01	7.8000E-03	1.3414E+01	8.0000E-03	1.3244E+01	8.2000E-03	1.3080E+01
86	8.4000E-03	1.2923E+01	8.6000E-03	1.2771E+01	8.8000E-03	1.2624E+01	9.0000E-03	1.2482E+01	9.2000E-03	1.2344E+01
91	9.4000E-03	1.2211E+01	9.6000E-03	1.2083E+01	9.8000E-03	1.1958E+01	1.0000E-02	1.1837E+01	1.2000E-02	1.0798E+01
96	1.4000E-02	9.9892E+00	1.6000E-02	9.3372E+00	1.8000E-02	8.7967E+00	2.0000E-02	8.3392E+00	2.2000E-02	7.9452E+00
101	2.4000E-02	7.6014E+00	2.5300E-02	7.4000E+00	2.6000E-02	7.2978E+00	2.8000E-02	7.0272E+00	3.0000E-02	6.7839E+00
106	3.2000E-02	6.5637E+00	3.4000E-02	6.3631E+00	3.6000E-02	6.1793E+00	3.8000E-02	6.0100E+00	4.0000E-02	5.8536E+00
111	4.2000E-02	5.7083E+00	4.4000E-02	5.5730E+00	4.6000E-02	5.4465E+00	4.8000E-02	5.3279E+00	5.0000E-02	5.2165E+00
116	5.2000E-02	5.1115E+00	5.4000E-02	5.0122E+00	5.6000E-02	4.9183E+00	5.8000E-02	4.8293E+00	6.0000E-02	4.7446E+00
121	6.2000E-02	4.6641E+00	6.4000E-02	4.5873E+00	6.6000E-02	4.5140E+00	6.8000E-02	4.4438E+00	7.0000E-02	4.3767E+00
126	7.2000E-02	4.3124E+00	7.4000E-02	4.2506E+00	7.6000E-02	4.1913E+00	7.8000E-02	4.1342E+00	8.0000E-02	4.0792E+00
131	8.2000E-02	4.0262E+00	8.4000E-02	3.9751E+00	8.6000E-02	3.9258E+00	8.8000E-02	3.8781E+00	9.0000E-02	3.8320E+00
136	9.2000E-02	3.7874E+00	9.4000E-02	3.7442E+00	9.6000E-02	3.7023E+00	9.8000E-02	3.6616E+00	1.0000E-01	3.6222E+00
141	1.2000E-01	3.2829E+00	1.4000E-01	3.0176E+00	1.6000E-01	2.8026E+00	1.8000E-01	2.6236E+00	2.0000E-01	2.4714E+00
146	2.2000E-01	2.3398E+00	2.4000E-01	2.2246E+00	2.5300E-01	2.1568E+00	2.6000E-01	2.1224E+00	2.8000E-01	2.0310E+00
151	3.0000E-01	1.9486E+00	3.2000E-01	1.8737E+00	3.4000E-01	1.8054E+00	3.6000E-01	1.7425E+00	3.8000E-01	1.6845E+00
156	4.0000E-01	1.6308E+00	4.2000E-01	1.5808E+00	4.4000E-01	1.5341E+00	4.6000E-01	1.4904E+00	4.8000E-01	1.4493E+00
161	5.0000E-01	1.4106E+00	5.2000E-01	1.3741E+00	5.4000E-01	1.3396E+00	5.6000E-01	1.3068E+00	5.8000E-01	1.2758E+00
166	6.0000E-01	1.2462E+00	6.2000E-01	1.2180E+00	6.4000E-01	1.1911E+00	6.6000E-01	1.1654E+00	6.8000E-01	1.1409E+00
171	7.0000E-01	1.1173E+00	7.2000E-01	1.0947E+00	7.4000E-01	1.0730E+00	7.6000E-01	1.0522E+00	7.8000E-01	1.0321E+00
176	8.0000E-01	1.0128E+00	8.2000E-01	9.9419E-01	8.4000E-01	9.7623E-01	8.6000E-01	9.5888E-01	8.8000E-01	9.4213E-01
181	9.0000E-01	9.2593E-01	9.2000E-01	9.1026E-01	9.4000E-01	8.9508E-01	9.6000E-01	8.8038E-01	9.8000E-01	8.6613E-01
186	1.0000E+00	8.5231E-01	1.2000E+00	7.3382E-01	1.4000E+00	6.4224E-01	1.6000E+00	5.6915E-01	1.6720E+00	5.4631E-01
191	1.8000E+00	5.0942E-01	2.0000E+00	4.5972E-01	2.2000E+00	4.1775E-01	2.4000E+00	3.8188E-01	2.5300E+00	3.6126E-01
196	2.6000E+00	3.5093E-01	2.8000E+00	3.2398E-01	3.0000E+00	3.0037E-01	3.2000E+00	2.7953E-01	3.4000E+00	2.6105E-01
201	3.6000E+00	2.4457E-01	3.8000E+00	2.2982E-01	4.0000E+00	2.1656E-01	4.2000E+00	2.0460E-01	4.4000E+00	1.9378E-01
206	4.6000E+00	1.8397E-01	4.8000E+00	1.7504E-01	5.0000E+00	1.6690E-01	5.2000E+00	1.5947E-01	5.4000E+00	1.5266E-01
211	5.4792E+00	1.5013E-01	5.6000E+00	1.4643E-01	5.8000E+00	1.4071E-01	6.0000E+00	1.3546E-01	6.2000E+00	1.3063E-01
216	6.4000E+00	1.2619E-01	6.6000E+00	1.2211E-01	6.8000E+00	1.1837E-01	6.8684E+00	1.1717E-01	7.0000E+00	1.1495E-01
221	7.2000E+00	1.1184E-01	7.4000E+00	1.0907E-01	7.4865E+00	1.0798E-01	7.6000E+00	1.0670E-01	7.8000E+00	1.0502E-01
226	7.8023E+00	1.0501E-01	7.9799E+00	1.0514E-01	8.0000E+00	1.0540E-01	8.0874E+00	1.0805E-01	8.1562E+00	1.1442E-01
231	8.2000E+00	1.2480E-01	8.2024E+00	1.2566E-01	8.2344E+00	1.4376E-01	8.2574E+00	1.7153E-01	8.2744E+00	2.1264E-01
236	8.2874E+00	2.7186E-01	8.2974E+00	3.5538E-01	8.3054E+00	4.7130E-01	8.3119E+00	6.3061E-01	8.3174E+00	8.4965E-01

241	8,3223E+00	1,1592E+00	8,3298E+00	1,9748E+00	8,3327E+00	2,4003E+00	8,3348E+00	2,7208E+00	8,3367E+00	2,9509E+00
246	8,3384E+00	3,0903E+00	8,3400E+00	3,1368E+00	8,3416E+00	3,0897E+00	8,3433E+00	2,9497E+00	8,3452E+00	2,7191E+00
251	8,3473E+00	2,3981E+00	8,3502E+00	1,9723E+00	8,3577E+00	1,1566E+00	8,3626E+00	8,4719E-01	8,3681E+00	6,2829E-01
256	8,3746E+00	4,6909E-01	8,3826E+00	3,5326E-01	8,3926E+00	2,6977E-01	8,4000E+00	2,3166E-01	8,4056E+00	2,1050E-01
261	8,4226E+00	1,6924E-01	8,4456E+00	1,4119E-01	8,4776E+00	1,2261E-01	8,5238E+00	1,1060E-01	8,5926E+00	1,0301E-01
266	8,6000E+00	1,0250E-01	8,7001E+00	9,8121E-02	8,8000E+00	9,5840E-02	8,8776E+00	9,4626E-02	9,0000E+00	9,3178E-02
271	9,1935E+00	9,1460E-02	9,2000E+00	9,1410E-02	9,4000E+00	9,0025E-02	9,6000E+00	8,8877E-02	9,8000E+00	8,7911E-02
276	9,8116E+00	8,7860E-02	1,0000E+01	8,7100E-02	1,0000E+01	0,0000E+00	7,4800E+02	0,0000E+00	7,4800E+02	1,4500E-01
281	9,0000E+02	1,6000E-01	1,0000E+03	1,6800E-01	1,2000E+03	1,8400E-01	1,4000E+03	1,9800E-01	1,6000E+03	2,1100E-01
286	1,8000E+03	2,2300E-01	2,0000E+03	2,3300E-01	2,2000E+03	2,4300E-01	2,4000E+03	2,5200E-01	2,6000E+03	2,6100E-01
291	2,8000E+03	2,7000E-01	3,0000E+03	2,7800E-01	3,2000E+03	2,8600E-01	3,6000E+03	2,9900E-01	3,9400E+03	3,0900E-01
296	3,9400E+03	0,0000E+00	4,0000E+03	0,0000E+00	5,0000E+04	0,0000E+00	5,0000E+04	4,2500E-01	6,0000E+04	3,8000E-01
301	7,0000E+04	3,3700E-01	8,0000E+04	3,0300E-01	9,0000E+04	2,7900E-01	1,0000E+05	2,6200E-01	1,1000E+05	2,4700E-01
306	1,2000E+05	2,3700E-01	1,3000E+05	2,2600E-01	1,4000E+05	2,1800E-01	1,5000E+05	2,1200E-01	1,7500E+05	2,0000E-01
311	2,0000E+05	1,9100E-01	2,2500E+05	1,8400E-01	2,5000E+05	1,7900E-01	2,7500E+05	1,7700E-01	3,0000E+05	1,7800E-01
316	6,0000E+05	1,8000E-01	6,5000E+05	1,7900E-01	7,0000E+05	1,7700E-01	7,5000E+05	1,7400E-01	8,0000E+05	1,7100E-01
321	8,5000E+05	1,6700E-01	9,0000E+05	1,6300E-01	9,5000E+05	1,5700E-01	1,0000E+06	1,5100E-01	1,2000E+06	1,2500E-01
326	1,4000E+06	1,0300E-01	1,8000E+06	7,5000E-02	2,5000E+06	4,7000E-02	3,5000E+06	2,9000E-02	7,0000E+06	1,1700E-02
331	1,1000E+07	6,9000E-03	1,5000E+07	4,9000E-03	2,0000E+07	2,9420E-03				



232 90 Th σnγ
72 FEI Ch
71 LRL Na
64 ORL Gi
63 ANL St
63 HAR Mo
63 CCP To
62 LRL Mi
61 CCP St
59 HAR Ha
59 ALD Ba
58 ALD Pe
58 CCP Be
En(eV)
σ(b)

REFERENCES FOR EXPERIMENTAL DATA

$^{232}Th(n,\gamma)$

Yr.	Lab	Author	References
72	FEI	Chelnokov, et al.	Jad. Fiz. Iss. 13, 6 (1972)
71	LRL	Nagle, et al.	Third Conf. Neutron Cross Sections & Tech., Knoxville, Tenn. Vol II, 259 (1971)
64	ORL	Gibbons	Priv. Comm. (1964)
63	ANL	Stupegia, et al.	J. Inorg. & Nuc. Chem. 25, 627 (1963)
63	HAR	Moxon, et al.	T.R.D.W.P/R-8 (1963)
63	CCP	Tolstikov, et al.	At. En. 15, 414 (1963)
62	LRL	Miskel, et al.	Phys. Rev. 128, 2717 (1962)
61	CCP	Stavisskii, et al.	At. En. 10, 508 (1961)
59	HAR	Hanna, et al.	J. Nuc.En. 8, 197 (1959)
59	ALD	Barry, et al.	Proc. Phys. Soc. 74, 685 (1959)
58	ALD	Perkin, et al.	Proc. Phys. Soc. 72, 505 (1958)
58	CCP	Belanova, et al.	Zh. Ex. Theo. Fiz. 34, 574 (1958)

92- U-235 LASL,AI EVAL-MAR74 L.STEWART, H.ALTER , R.HUNTER
DIST-1974

P.C. TO NORMALIZATION AND STANDARDS SUBCOMMITTEE MARCH 1974
PERTINENT HOLLORITH FROM GENERAL FILE FOLLOWS (MAT 1261)
ALL REFERENCES CARRIED OVER FROM GENERAL FILE
PRINCIPAL EVALUATORS- L.STEWART LASL, H.ALTER AI, R.HUNTER LASL
CONTRIBUTING EVALUATORS

NU-BAR--B.R. LEONARD BNW, L. STEWART AND RAY HUNTER LASL, HUMMEL ANL.
F.P.YIELDS--R.SCHENTER HEDL. FISSION PROD. SUBCOMMITTEE
DELAYED NEUTRON DATA--H.HUMMEL ANL
RADIOACTIVE DECAY DATA--C.W.REICH ANC
RESOLVED RESONANCE DATA--J.R. SMITH ANC, R. GWIN, R. PEELE, AND G.DESAUSSURE ORNL

SMOOTH DATA

THERMAL RANGE C.LUBITZ KAPL, J.HARDY BAPL, B.R.LEONARD BNW
82 EV -25 KEV--R.GWIN, G.DESAUSSURE ORNL, R.BLOCK RPI, J.R. SMITH ANC
25 KEV-1 MEV A.CARLSON NBS, W.POENITZ ANL, L.STEWART LASL, H.ALTER
1 MEV-20 MEV--R.HUNTER, L.STEWART LASL, H.ALTER
INELASTIC SCAT--L.STEWART, R.HUNTER LASL
SECONDARY NEUTRON DIST.--L.STEWART, R.HUNTER LASL
GAMMA PRODUCTION--R.HUNTER, L.STEWART LASL

EVALUATIONS WILL BE DESCRIBED AND REFERENCED IN---TBD---

BASES FOR EVALUATIONS

CURRENT FILE 1 COMMENTS ARE RELATIVE TO EVALUATION BETWEEN 25 KEV AND 20 MEV. ADDITIONAL FILE 1 COMMENTS ARE TO BE PROVIDED KAPL AND BAPL (DATA BELOW 1.0 EV), ORNL AND BNL WILL PROVIDE COMMENTS FOR UNRESOLVED ENERGY REGION-82.0 EV TO 25 KEV. ALL ADDITIONAL FILE 1 COMMENTS ARE TO BE FORWARDED TO STEWART WHO WILL COORDINATE AND SET UP NEW FILE 1 COMMENT FIELDS.

MF = 2

RESOLVED RESONANCE REGION
RESOLVED RESONANCE REGION REMAINS UNCHANGED FROM ENDF/B-3, ANC REPORT BY J.R.SMITH APPROPRIATE REFERENCE---TBD.

UNRESOLVED RESONANCE REGION
COMMENTS ON EVALUATION IN THIS REGION WILL BE PROVIDED BY ORNL (PEELLE) AND BNL (BHAT)

MF = 3

SMOOTH DATA

THERMAL DATA---COMMENTS---TBD,
1 EV TO 82 EV   COMMENTS---TBD- J.R. SMITH
82 EV TO 25 KEV COMMENTS---TBD- PEELLE, BHAT
25 KEV TO 100 KEV
100KEV TO 1 MEV---FISSION CROSS SECTION TAKEN AS CURVE SUGGESTED BY U-235 TASK FORCE AND CSEWG STANDARDS AND NORMALIZATION SUBCOMMITTEE, IN THIS ENERGY REGION DATA TAKEN FROM REFERENCES 1 THROUGH 9, DATA OF REF.4 SZABO (71) RAISED BY 1.04, BETWEEN 1 AND 6 MEV CURVE DRAWN THROUGH DATA OF REFERENCES 3, 5, AND 7 THROUGH 11, WITH HEAVY WEIGHT GIVEN TO REF. 11, ABOVE 6 MEV CURVE DRAWN THROUGH DATA OF REFERENCES 7, 8, 12 AND 13, DATA OF REFS. 12 AND 13 NORMALIZED TO 2.152 BARNS AT 14.0 MEV.---ALPHA CURVE BETWEEN 10 KEV AND 10 MEV BASED ON REFERENCES 1 AND 14 THROUGH 19 AS RECOMMENDED BY U-235 TASK FORCE. ABOVE 1 MEV ALPHA CURVE SMOOTHLY EXTRAPOLATED TO 20 MEV.---CAPTURE CROSS SECTION DERIVED AS THE PRODUCT OF THE FISSION CROSS SECTION WITH ALPHA---ABOVE 0.5 MEV TOTAL CROSS SECTION TAKEN FROM SPLINE FIT TO DATA OF REFERENCES 20 AND 21, BETWEEN 25 KEV AND 0.5 MEV A SMOOTH CURVE WAS FIT TO THE TOTAL CROSS SECTION OF ENDF/B-3,

REFERENCES

1. GWIN, R., ET.AL. PRIVATE COMMUNICATION (ORNL,1973)
2. KAPPELER,F.SYMPOSIUM NEUT.STDS., (ANL) CONF.701002, 272(1970)
3. SZABO,I., ET.AL., (AS REF.5) CONF-701002, 257(1970)
4. SZABO,I., ET.AL., KNOXVILLE CONF, VOL.2 573(1971)
5. KAPPELER,F., 2ND IAEA PANEL STANDARD X-SECTIONS,VIENNA(1972)
6. GAYTHER, D.B., ET.AL., (AS REF.8) (1972)
7. HANSEN, G., ET.AL., PRIVATE COMMUNICATION,L.STEWART(LASL 1970)
8. WHITE, P.H.., J.NUCL.ENERGY 19,325(1965)
9. DIVEN, B.C., PHYS.REV,105,1350(1957)
10. POENITZ, W., PRIVATE COMMUNICATION (ANL,1973)
11. HANSEN, G., ET.AL., PRIVATE COMMUNICATION,L.STEWART (1972)
12. PANKRATOV, V.M., ET.AL., J.NUCL.ENERGY 16,494 (1962)
13. PANKRATOV, V.M., ET.AL., SOVIET J.AT.ENERGY 14,167 (1963)
14. DESAUSSURE, G., ET.AL., PARIS 1966, IAEA 2,233 (1967)
15. CZIRR, J.B., ET.AL., HELSINKI 1970, IAEA 1,331 (1970)
16. PEREZ, R.B., ET.AL., ORNL-TM-3696 (1972)
17. BANDL, R.E., ET.AL., NSE 48,324 (1972)
18. KONONOV, V.N., ET.AL., INDC(CCP)-21L, (1971)
19. KUROV, M.A., ET.AL., J. SOVIET AT.ENRGY, 315,(MARCH 1971)
20. HEATON, P.C. ET.AL., PRIVATE COMMUNICATION (NBS,1972)
21. FOSTER, D.G. ET.AL., PHYS.REV,C3,576 (1971)
22. HUNTER, R.E. STEWART, L., HIRONS T.J., LA-5173 (1973)
23. KAMMERDIENER, J.L., UCRL-51232 (1972)
24. HUNTER, R.E. STEWART, L., LA-4901 (1972)

25. DRAKE, D.M., HOPKINS, J.C., YOUNG, C.S. AND CONDE, H., NSE 40, 290 (1970)
26. NELLIS, D.O., AND MORGAN, I.L., ORO-2791-17 (1966), ALSO BUCHANAN, P.S., ORO-2791-28 (1969)

REACTION	ERROR FILE ENERGY RANGE	ESTIMATED ERROR (IN PERCENT)
FISSION	25 KEV TO 1.0 MEV	4
FISSION	1.0 MEV TO 1.5 MEV	5
FISSION	1.5 MEV TO 2.0 MEV	3
FISSION	2.0 MEV TO 5.0 MEV	4
FISSION	5.0 MEV TO 6.0 MEV	7
FISSION	6.0 MEV TO 20 MEV	10
ALPHA	25 KEV TO 1.0 MEV	10
TOTAL	0.5 MEV TO 20 MEV	2

---- ---- ---- ---- ----

URANIUM-235

ENDF/B MATERIAL NO. 6261

TABLE OF CONTENTS

GENERAL INFORMATION

DATA TYPE	REACTION	CARDS
GENERAL INFORMATION	COMMENTS	119
	TABLE OF CONTENTS	3
RESONANCE PARAMETERS	RESONANCE DATA	871
NEUTRON CROSS SECTION	FISSION	273

URANIUM-235

ENDF/B MATERIAL NO. 6261

RESONANCE DATA

RESONANCE PARAMETERS

ISOTOPE---------------------URANIUM-235
FRACTIONAL ABUNDANCE---------- 1.0000E+00
NUMBER OF ENERGY RANGES------ 2

ENERGY RANGE NUMBER---------- 1
LOWER ENERGY LIMIT (EV)------ 1.0000E+00
UPPER ENERGY LIMIT (EV)------ 8.2000E+01
NUCLEAR SPIN---------------- 3.5000E+00
SPIN SCATTERING LENGTH (A+)-- 9.5663E-01
NUMBER OF L STATES---------- 1

RESOLVED SINGLE-LEVEL BREIT-WIGNER PARAMETERS

L VALUE--------------------- 0
NUMBER OF RESONANCES-------- 130
SPIN SCATTERING LENGTH (A-)-- 0.0000E+00

			RESONANCE WIDTHS (EV)			
INDEX	ENERGY (EV)	J VALUE	TOTAL	NEUTRON	RADIATION	FISSION
1	-1.4900E+00	3.5000E+00	2.3768E-01	3.6820E-03	2.7000E-02	2.0700E-01
2	2.9000E-01	3.5000E+00	1.3500E-01	3.0157E-06	3.6000E-02	9.9000E-02
3	1.1400E+00	3.5000E+00	1.5082E-01	1.5161E-05	3.4600E-02	1.1620E-01
4	2.0350E+00	3.5000E+00	4.4696E-02	7.6605E-06	3.4874E-02	9.8140E-03
5	2.9200E+00	3.5000E+00	2.2000E-01	4.8530E-06	2.0000E-02	2.0000E-01
6	3.1470E+00	3.5000E+00	1.3961E-01	2.2405E-05	3.3210E-02	1.0637E-01
7	3.6090E+00	3.5000E+00	8.4379E-02	4.5594E-05	3.3696E-02	5.0637E-02
8	4.8480E+00	3.5000E+00	3.9592E-02	6.0352E-05	3.5945E-02	3.5870E-03
9	5.4480E+00	3.5000E+00	9.0120E-02	3.3611E-06	6.0000E-02	3.0117E-02
10	5.6000E+00	3.5000E+00	6.4192E-01	3.3319E-05	2.0000E-02	6.2189E-01
11	6.2100E+00	3.5000E+00	2.3090E-01	6.3795E-05	4.3469E-02	1.8736E-01
12	6.3820E+00	3.5000E+00	4.4788E-02	2.6834E-04	3.4972E-02	9.5480E-03
13	7.0770E+00	3.5000E+00	6.3934E-02	1.2660E-04	3.5574E-02	2.8233E-02
14	8.7810E+00	3.5000E+00	1.2329E-01	1.1234E-03	3.1170E-02	9.1000E-02
15	9.2860E+00	3.5000E+00	1.1076E-01	1.6364E-04	3.5600E-02	7.5000E-02
16	9.7300E+00	3.5000E+00	2.6905E-01	5.3028E-05	3.2000E-02	2.3700E-01
17	1.0180E+01	3.5000E+00	1.0056E-01	6.1898E-05	3.8000E-02	6.2500E-02
18	1.0800E+01	3.5000E+00	9.3509E-01	9.3332E-05	6.7000E-02	8.6800E-01
19	1.1666E+01	3.5000E+00	4.7277E-02	6.2744E-04	4.0400E-02	6.2500E-03
20	1.2396E+01	3.5000E+00	6.3262E-02	1.2622E-03	3.4500E-02	2.7500E-02
21	1.2861E+01	3.5000E+00	1.1955E-01	5.3076E-05	3.3500E-02	8.6000E-02
22	1.3275E+01	3.5000E+00	1.5144E-01	5.9350E-05	2.8600E-02	1.2280E-01
23	1.3700E+01	3.5000E+00	1.2394E-01	3.7013E-05	3.0400E-02	9.3500E-02
24	1.3996E+01	3.5000E+00	4.9654E-01	5.3723E-04	2.6000E-02	4.7000E-01
25	1.4544E+01	3.5000E+00	5.6215E-02	1.1517E-04	3.5200E-02	2.0900E-02
26	1.5406E+01	3.5000E+00	7.8837E-02	2.3707E-04	3.5300E-02	4.3300E-02
27	1.6088E+01	3.5000E+00	5.0361E-02	3.6099E-04	3.1383E-02	1.8617E-02
28	1.6667E+01	3.5000E+00	1.3327E-01	2.7300E-04	3.2105E-02	1.0089E-01
29	1.8052E+01	3.5000E+00	1.6038E-01	3.8451E-04	3.5000E-02	1.2500E-01
30	1.8960E+01	3.5000E+00	1.0512E-01	1.1582E-04	5.0000E-02	5.5000E-02
31	1.9297E+01	3.5000E+00	9.8194E-02	3.1936E-03	3.4821E-02	6.0179E-02
32	2.0130E+01	3.5000E+00	2.4009E-01	8.7714E-05	1.3910E-02	2.2609E-01
33	2.0200E+01	3.5000E+00	5.0013E-02	1.3034E-05	4.9280E-02	7.2000E-04
34	2.0610E+01	3.5000E+00	8.4191E-02	1.9117E-04	4.0485E-02	4.3515E-02
35	2.1072E+01	3.5000E+00	7.3503E-02	1.5027E-03	4.0342E-02	3.1658E-02
36	2.2939E+01	3.5000E+00	7.5436E-02	4.3584E-04	3.2670E-02	4.2330E-02
37	2.3412E+01	3.5000E+00	3.2204E-02	7.0372E-04	2.6500E-02	5.0000E-03
38	2.3629E+01	3.5000E+00	2.2586E-01	8.5577E-04	4.3000E-02	1.8200E-01
39	2.4245E+01	3.5000E+00	5.8268E-02	2.6835E-04	3.1000E-02	2.7000E-02

40	2,4370E+01	3,5000E+00	1,0015E-01	1,4958E-04	3,5000E-02	6,5000E-02
41	2,5200E+01	3,5000E+00	8,5068E-01	6,7624E-04	2,5000E-02	8,2500E-01
42	2,5590E+01	3,5000E+00	3,8556E-01	5,6455E-04	2,5000E-02	3,6000E-01
43	2,6480E+01	3,5000E+00	1,9248E-01	4,7599E-04	3,2000E-02	1,6000E-01
44	2,6740E+01	3,5000E+00	2,5009E-01	8,5685E-05	3,0000E-02	2,2000E-01
45	2,7149E+01	3,5000E+00	1,1559E-01	8,5139E-05	4,2000E-02	7,3500E-02
46	2,7796E+01	3,5000E+00	1,2067E-01	6,7447E-04	3,2000E-02	8,8000E-02
47	2,8090E+01	3,5000E+00	6,5031E-02	3,1164E-05	4,0000E-02	2,5000E-02
48	2,8351E+01	3,5000E+00	1,4919E-01	1,8854E-04	3,1700E-02	1,1730E-01
49	2,8710E+01	3,5000E+00	1,3004E-01	4,5009E-05	5,0000E-02	8,0000E-02
50	2,9644E+01	3,5000E+00	6,1177E-02	1,7744E-04	3,7000E-02	2,4000E-02
51	3,0590E+01	3,5000E+00	1,5523E-01	2,2732E-04	4,5094E-02	1,0990E-01
52	3,0860E+01	3,5000E+00	5,4532E-02	5,3235E-04	3,5269E-02	1,8731E-02
53	3,2070E+01	3,5000E+00	9,9823E-02	1,8233E-03	3,7724E-02	6,0276E-02
54	3,3520E+01	3,5000E+00	5,6859E-02	1,8595E-03	3,1861E-02	2,3139E-02
55	3,4370E+01	3,5000E+00	8,7253E-02	2,2527E-03	4,3160E-02	4,1840E-02
56	3,4850E+01	3,5000E+00	1,1610E-01	1,0977E-03	3,8247E-02	7,6753E-02
57	3,5187E+01	3,5000E+00	1,0350E-01	3,5004E-03	3,1402E-02	6,8598E-02
58	3,5300E+01	3,5000E+00	6,9157E-01	1,5675E-03	4,0000E-02	6,5000E-01
59	3,6400E+01	3,5000E+00	1,5401E+00	1,1994E-04	4,0000E-02	1,5000E+00
60	3,7500E+01	3,5000E+00	1,5402E+00	1,6638E-04	4,0000E-02	1,5000E+00
61	3,8300E+01	3,5000E+00	3,0834E-01	3,3592E-04	4,2191E-02	2,6581E-01
62	3,9410E+01	3,5000E+00	9,5523E-02	2,5233E-03	3,4488E-02	5,8512E-02
63	3,9900E+01	3,5000E+00	1,5024E-01	2,3637E-04	3,3177E-02	1,1682E-01
64	4,0536E+01	3,5000E+00	2,0938E-01	3,8029E-04	3,4323E-02	1,7468E-01
65	4,1350E+01	3,5000E+00	4,4564E-01	6,4484E-04	4,5000E-02	4,0000E-01
66	4,1590E+01	3,5000E+00	1,6522E-01	2,2391E-04	3,0907E-02	1,3409E-01
67	4,1873E+01	3,5000E+00	4,1233E-02	1,2325E-03	2,8951E-02	1,1049E-02
68	4,2230E+01	3,5000E+00	1,4545E-01	4,4722E-04	4,8240E-02	9,6760E-02
69	4,2690E+01	3,5000E+00	6,1345E-02	3,4518E-04	4,4322E-02	1,6678E-02
70	4,3390E+01	3,5000E+00	7,0754E-02	7,5449E-04	4,5880E-02	2,4120E-02
71	4,3900E+01	3,5000E+00	1,1020E-01	2,0096E-04	4,1036E-02	6,8964E-02
72	4,3970E+01	3,5000E+00	2,5034E-01	3,4547E-04	1,7309E-02	2,3269E-01
73	4,4600E+01	3,5000E+00	1,7584E-01	8,3866E-04	4,5978E-02	1,2902E-01
74	4,4950E+01	3,5000E+00	5,3576E-01	7,5700E-04	3,0739E-02	5,0426E-01
75	4,5790E+01	3,5000E+00	1,3419E-01	1,8791E-04	4,0807E-02	9,3193E-02
76	4,6790E+01	3,5000E+00	1,5280E-01	8,0305E-04	3,7000E-02	1,1500E-01
77	4,7011E+01	3,5000E+00	1,3994E-01	9,3659E-04	4,2000E-02	9,7000E-02
78	4,7970E+01	3,5000E+00	9,3988E-02	9,8834E-04	4,5710E-02	4,7290E-02
79	4,8300E+01	3,5000E+00	1,6577E-01	7,7094E-04	2,4715E-02	1,4028E-01
80	4,8800E+01	3,5000E+00	6,5691E-02	6,9061E-04	2,5431E-02	3,9569E-02
81	4,9000E+01	3,5000E+00	2,4018E-01	1,7675E-04	2,0000E-02	2,2000E-01
82	4,9418E+01	3,5000E+00	6,1013E-02	1,0132E-03	4,2913E-02	1,7087E-02
83	5,0108E+01	3,5000E+00	5,4353E-02	3,1585E-04	3,1094E-02	2,2943E-02
84	5,0460E+01	3,5000E+00	7,5964E-02	9,6365E-04	3,2030E-02	4,2970E-02
85	5,0780E+01	3,5000E+00	3,3019E-01	1,8955E-04	3,0000E-02	3,0000E-01
86	5,1268E+01	3,5000E+00	1,8834E-01	3,5448E-03	5,1974E-02	1,3303E-01
87	5,1630E+01	3,5000E+00	7,4346E-02	3,4569E-04	3,3454E-02	4,0546E-02
88	5,2221E+01	3,5000E+00	3,6351E-01	2,5076E-03	3,1000E-02	3,3000E-01
89	5,3438E+01	3,5000E+00	1,3554E-01	5,3729E-04	3,3463E-02	1,0154E-01
90	5,4132E+01	3,5000E+00	1,5021E-01	2,1410E-04	4,4000E-02	1,0600E-01
91	5,5064E+01	3,5000E+00	1,1117E-01	3,1685E-03	4,8539E-02	5,9461E-02
92	5,5840E+01	3,5000E+00	2,5135E-01	2,3549E-03	3,8719E-02	2,1028E-01
93	5,6070E+01	3,5000E+00	1,9079E-01	7,8624E-04	3,0000E-02	1,6000E-01
94	5,6498E+01	3,5000E+00	1,1992E-01	4,9208E-03	3,9167E-02	7,5833E-02
95	5,7800E+01	3,5000E+00	2,2113E-01	1,1252E-03	3,5000E-02	1,8500E-01
96	5,8060E+01	3,5000E+00	6,5354E-02	1,3539E-03	3,2315E-02	3,1685E-02
97	5,8674E+01	3,5000E+00	1,3633E-01	1,3328E-03	3,3000E-02	1,0200E-01
98	5,9760E+01	3,5000E+00	2,5527E-01	2,7057E-04	4,2000E-02	2,1300E-01
99	6,0188E+01	3,5000E+00	2,5513E-01	1,1265E-03	3,4000E-02	2,2000E-01
100	6,0837E+01	3,5000E+00	1,2046E-01	4,6253E-04	3,0000E-02	9,0000E-02
101	6,1130E+01	3,5000E+00	1,2536E-01	3,6278E-04	4,0000E-02	8,5000E-02
102	6,1570E+01	3,5000E+00	5,3023E-01	2,2520E-04	3,0000E-02	5,0000E-01
103	6,1900E+01	3,5000E+00	5,3017E-01	1,7073E-04	3,0000E-02	5,0000E-01
104	6,2400E+01	3,5000E+00	4,6026E-01	2,6163E-04	6,0000E-02	4,0000E-01
105	6,3020E+01	3,5000E+00	2,4009E-01	9,0896E-05	4,0000E-02	2,0000E-01
106	6,3320E+01	3,5000E+00	2,5010E-01	1,0209E-04	5,0000E-02	2,0000E-01
107	6,3690E+01	3,5000E+00	6,2107E-01	1,0744E-03	6,0000E-02	5,6000E-01
108	6,4300E+01	3,5000E+00	4,7545E-02	1,2447E-03	3,9000E-02	7,3000E-03
109	6,5800E+01	3,5000E+00	9,6423E-02	4,2327E-04	5,0000E-02	4,6000E-02
110	6,6402E+01	3,5000E+00	8,9449E-02	4,4948E-04	4,5000E-02	4,4000E-02
111	6,7247E+01	3,5000E+00	9,0081E-02	8,0938E-05	4,1000E-02	4,9000E-02
112	6,8440E+01	3,5000E+00	2,5004E-01	3,7641E-05	5,0000E-02	2,0000E-01
113	6,8530E+01	3,5000E+00	1,6011E-01	1,0836E-04	6,0000E-02	1,0000E-01
114	6,9293E+01	3,5000E+00	2,0072E-01	7,1530E-04	4,0000E-02	1,6000E-01
115	7,0404E+01	3,5000E+00	1,7272E-01	2,7156E-03	5,0000E-02	1,2000E-01
116	7,0750E+01	3,5000E+00	2,3741E-01	2,4091E-03	3,5000E-02	2,0000E-01
117	7,1610E+01	3,5000E+00	1,6029E-01	2,9136E-04	4,0000E-02	1,2000E-01
118	7,2390E+01	3,5000E+00	1,3861E-01	2,6115E-03	3,1000E-02	1,0500E-01
119	7,2910E+01	3,5000E+00	3,6037E-01	3,6717E-04	4,0000E-02	3,2000E-01
120	7,4544E+01	3,5000E+00	1,0167E-01	2,7287E-03	3,8000E-02	6,0937E-02
121	7,5170E+01	3,5000E+00	2,9089E-01	8,8833E-04	5,0000E-02	2,4000E-01
122	7,5541E+01	3,5000E+00	2,3336E-01	1,3621E-03	3,2000E-02	2,0000E-01
123	7,6750E+01	3,5000E+00	1,1611E-01	1,0732E-04	3,6000E-02	8,0000E-02
124	7,7492E+01	3,5000E+00	1,1299E-01	9,8681E-04	4,0000E-02	7,2000E-02
125	7,8117E+01	3,5000E+00	1,4822E-01	1,2245E-03	4,7000E-02	1,0000E-01
126	7,9672E+01	3,5000E+00	1,2979E-01	7,8557E-04	4,4000E-02	8,5000E-02
127	8,0357E+01	3,5000E+00	1,7484E-01	8,3851E-04	4,0000E-02	1,3400E-01
128	8,1434E+01	3,5000E+00	1,3204E-01	1,0433E-03	4,1000E-02	9,0000E-02
129	8,3590E+01	3,5000E+00	1,1827E-01	1,1703E-03	4,8000E-02	6,9100E-02
130	8,6880E+01	3,5000E+00	8,0120E-02	7,1958E-04	5,2000E-02	2,7400E-02

URANIUM-235

ENDF/B MATERIAL NO. 6261

RESONANCE DATA
RESONANCE PARAMETERS

ISOTOPE----------------------------URANIUM-235
FRACTIONAL ABUNDANCE---------- 1.0000E+00
NUMBER OF ENERGY RANGES------ 2

ENERGY RANGE NUMBER----------- 2

UNRESOLVED SINGLE-LEVEL BREIT-WIGNER PARAMETERS

LOWER ENERGY LIMIT (EV)------ 8.2000E+01
UPPER ENERGY LIMIT (EV)------ 2.5000E+04
NUCLEAR SPIN----------------- 3.5000E+00
EFFECTIVE SCATTERING RADIUS-- 9.5663E-01
NUMBER OF L STATES----------- 2

L VALUE---------------------- 0
NUMBER OF J STATES----------- 2

DEGREES OF FREEDOM USED IN THE WIDTH DISTRIBUTION

J-VALUE	COMPETITIVE	NEUTRON	RADIATION	FISSION
3.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	2.0000E+00

			AVERAGE RESONANCE WIDTHS (EV)			
INDEX	ENERGY (EV)	LEVEL SPACING	COMPETITIVE	NEUTRON	RADIATION	FISSION
1	8.2000E+01	1.0000E+00	0.0000E+00	9.3278E-05	3.5000E-02	3.2328E-01
2	8.6500E+01	1.0000E+00	0.0000E+00	8.4486E-05	3.5000E-02	3.4056E-01
3	9.1000E+01	1.0000E+00	0.0000E+00	8.5939E-05	3.5000E-02	2.6394E-01
4	9.5500E+01	1.0000E+00	0.0000E+00	8.7318E-05	3.5000E-02	2.0598E-01
5	1.0000E+02	1.0000E+00	0.0000E+00	9.9434E-05	3.5000E-02	8.4620E-02
6	1.1000E+02	1.0000E+00	0.0000E+00	8.6620E-05	3.5000E-02	1.3225E-01
7	1.2000E+02	1.0000E+00	0.0000E+00	1.0427E-04	3.5000E-02	2.9946E-01
8	1.8000E+02	1.0000E+00	0.0000E+00	9.8358E-05	3.5000E-02	2.4919E-01
9	2.4000E+02	1.0000E+00	0.0000E+00	1.3181E-04	3.5000E-02	3.0695E-01
10	2.6000E+02	1.0000E+00	0.0000E+00	2.1003E-05	3.5000E-02	1.0310E+00
11	2.8000E+02	1.0000E+00	0.0000E+00	9.3538E-05	3.5000E-02	7.5330E-01
12	2.9000E+02	1.0000E+00	0.0000E+00	7.0914E-05	3.5000E-02	5.5909E-01
13	3.0000E+02	1.0000E+00	0.0000E+00	8.0412E-05	3.5000E-02	3.2833E-01
14	3.1500E+02	1.0000E+00	0.0000E+00	7.9453E-05	3.5000E-02	3.3064E-01
15	3.3000E+02	1.0000E+00	0.0000E+00	9.9192E-05	3.5000E-02	1.8560E-01
16	3.4500E+02	1.0000E+00	0.0000E+00	8.4286E-05	3.5000E-02	3.4234E-01
17	3.6000E+02	1.0000E+00	0.0000E+00	8.9227E-05	3.5000E-02	3.5757E-01
18	4.5000E+02	1.0000E+00	0.0000E+00	9.3838E-05	3.5000E-02	4.8869E-01
19	5.2000E+02	1.0000E+00	0.0000E+00	1.1974E-04	3.5000E-02	5.0149E-01
20	5.6500E+02	1.0000E+00	0.0000E+00	1.1742E-04	3.5000E-02	1.0843E+00
21	6.1000E+02	1.0000E+00	0.0000E+00	1.0711E-04	3.5000E-02	9.2310E-01
22	6.2000E+02	1.0000E+00	0.0000E+00	1.0825E-04	3.5000E-02	6.5530E-01
23	6.3000E+02	1.0000E+00	0.0000E+00	9.5608E-05	3.5000E-02	1.7554E-01
24	6.4000E+02	1.0000E+00	0.0000E+00	1.1968E-04	3.5000E-02	1.0701E-01
25	6.5000E+02	1.0000E+00	0.0000E+00	1.0641E-04	3.5000E-02	3.2751E-01
26	6.6000E+02	1.0000E+00	0.0000E+00	8.6759E-05	3.5000E-02	4.2087E-01
27	7.1000E+02	1.0000E+00	0.0000E+00	9.8628E-05	3.5000E-02	6.4322E-01
28	7.2500E+02	1.0000E+00	0.0000E+00	1.1895E-04	3.5000E-02	4.1650E-01
29	7.4000E+02	1.0000E+00	0.0000E+00	1.3378E-04	3.5000E-02	1.9020E-01
30	7.5500E+02	1.0000E+00	0.0000E+00	1.1936E-04	3.5000E-02	3.2629E-01
31	7.7000E+02	1.0000E+00	0.0000E+00	1.0512E-04	3.5000E-02	3.9003E-01
32	8.8000E+02	1.0000E+00	0.0000E+00	8.7337E-05	3.5000E-02	2.3209E-01
33	9.1000E+02	1.0000E+00	0.0000E+00	1.0180E-04	3.5000E-02	2.1179E-01
34	9.9000E+02	1.0000E+00	0.0000E+00	1.0457E-04	3.5000E-02	1.3706E-01
35	1.0850E+03	1.0000E+00	0.0000E+00	1.1153E-04	3.5000E-02	3.3829E-01
36	1.1800E+03	1.0000E+00	0.0000E+00	1.2142E-04	3.5000E-02	5.3589E-01
37	1.2200E+03	1.0000E+00	0.0000E+00	8.7624E-05	3.5000E-02	3.2579E-01
38	1.3000E+03	1.0000E+00	0.0000E+00	9.0564E-05	3.5000E-02	5.0301E-01
39	1.4000E+03	1.0000E+00	0.0000E+00	1.0446E-04	3.5000E-02	6.0201E-01
40	1.4300E+03	1.0000E+00	0.0000E+00	1.3656E-04	3.5000E-02	2.4704E-01
41	1.4500E+03	1.0000E+00	0.0000E+00	1.1221E-04	3.5000E-02	6.3519E-01
42	1.4600E+03	1.0000E+00	0.0000E+00	1.1391E-04	3.5000E-02	6.2704E-01
43	1.4800E+03	1.0000E+00	0.0000E+00	6.4821E-05	3.5000E-02	1.6471E-01
44	1.5000E+03	1.0000E+00	0.0000E+00	7.0660E-05	3.5000E-02	1.9345E-01
45	1.5450E+03	1.0000E+00	0.0000E+00	8.6144E-05	3.5000E-02	4.2664E-01
46	1.5900E+03	1.0000E+00	0.0000E+00	1.0195E-04	3.5000E-02	5.3814E-01
47	1.7000E+03	1.0000E+00	0.0000E+00	9.5054E-05	3.5000E-02	5.3743E-01
48	1.9000E+03	1.0000E+00	0.0000E+00	9.4274E-05	3.5000E-02	3.0525E-01
49	1.9100E+03	1.0000E+00	0.0000E+00	1.1239E-04	3.5000E-02	4.3576E-01
50	2.0000E+03	1.0000E+00	0.0000E+00	1.0774E-04	3.5000E-02	2.9444E-01
51	2.1000E+03	1.0000E+00	0.0000E+00	8.5182E-05	3.5000E-02	2.9599E-01
52	2.3000E+03	1.0000E+00	0.0000E+00	9.0730E-05	3.5000E-02	5.1877E-01
53	2.5000E+03	1.0000E+00	0.0000E+00	9.6107E-05	3.5000E-02	5.4289E-01
54	2.7000E+03	1.0000E+00	0.0000E+00	8.4700E-05	3.5000E-02	5.3117E-01
55	3.2000E+03	1.0000E+00	0.0000E+00	9.8708E-05	3.5000E-02	4.0938E-01
56	3.3000E+03	1.0000E+00	0.0000E+00	9.3389E-05	3.5000E-02	6.5952E-01
57	3.4000E+03	1.0000E+00	0.0000E+00	8.8321E-05	3.5000E-02	6.7381E-01
58	3.7500E+03	1.0000E+00	0.0000E+00	9.2666E-05	3.5000E-02	6.3354E-01
59	4.1000E+03	1.0000E+00	0.0000E+00	9.7037E-05	3.5000E-02	3.6854E-01
60	4.3000E+03	1.0000E+00	0.0000E+00	1.1061E-04	3.5000E-02	6.0392E-01
61	4.4000E+03	1.0000E+00	0.0000E+00	9.8661E-05	3.5000E-02	5.2563E-01
62	4.8000E+03	1.0000E+00	0.0000E+00	9.1578E-05	3.5000E-02	3.3330E-01
63	4.9000E+03	1.0000E+00	0.0000E+00	8.5575E-05	3.5000E-02	5.8387E-01
64	5.0000E+03	1.0000E+00	0.0000E+00	7.9647E-05	3.5000E-02	6.8119E-01
65	5.1000E+03	1.0000E+00	0.0000E+00	8.3750E-05	3.5000E-02	5.5989E-01
66	5.2000E+03	1.0000E+00	0.0000E+00	8.8593E-05	3.5000E-02	3.0084E-01

67	5.2500E+03	1.0000E+00	0.0000E+00	8.3996E-05	3.5000E-02	5.3535E-01
68	5.3000E+03	1.0000E+00	0.0000E+00	8.0355E-05	3.5000E-02	6.2110E-01
69	5.6000E+03	1.0000E+00	0.0000E+00	9.6242E-05	3.5000E-02	9.1282E-01
70	5.6500E+03	1.0000E+00	0.0000E+00	9.2935E-05	3.5000E-02	6.8495E-01
71	5.7000E+03	1.0000E+00	0.0000E+00	8.9486E-05	3.5000E-02	3.2335E-01
72	5.9000E+03	1.0000E+00	0.0000E+00	1.3332E-04	3.5000E-02	2.3718E-01
73	6.0000E+03	1.0000E+00	0.0000E+00	1.0338E-04	3.5000E-02	1.5481E-01
74	6.1000E+03	1.0000E+00	0.0000E+00	1.0003E-04	3.5000E-02	3.0015E-01
75	6.4500E+03	1.0000E+00	0.0000E+00	9.3122E-05	3.5000E-02	4.3992E-01
76	6.8000E+03	1.0000E+00	0.0000E+00	8.2825E-05	3.5000E-02	4.3291E-01
77	7.0000E+03	1.0000E+00	0.0000E+00	9.8898E-05	3.5000E-02	5.6308E-01
78	7.2000E+03	1.0000E+00	0.0000E+00	9.3412E-05	3.5000E-02	3.3987E-01
79	8.1000E+03	1.0000E+00	0.0000E+00	9.1247E-05	3.5000E-02	2.6692E-01
80	8.3000E+03	1.0000E+00	0.0000E+00	1.0663E-04	3.5000E-02	1.4558E-01
81	8.5000E+03	1.0000E+00	0.0000E+00	1.1115E-04	3.5000E-02	2.7862E-01
82	8.7000E+03	1.0000E+00	0.0000E+00	1.1565E-04	3.5000E-02	2.9922E-01
83	9.0000E+03	1.0000E+00	0.0000E+00	7.5325E-05	3.5000E-02	4.3771E-01
84	9.2000E+03	1.0000E+00	0.0000E+00	1.0652E-04	3.5000E-02	3.5324E-01
85	1.0400E+04	1.0000E+00	0.0000E+00	9.4242E-05	3.5000E-02	2.8175E-01
86	1.1400E+04	1.0000E+00	0.0000E+00	1.0069E-04	3.5000E-02	3.4881E-01
87	1.1700E+04	1.0000E+00	0.0000E+00	8.0284E-05	3.5000E-02	2.5643E-01
88	1.1900E+04	1.0000E+00	0.0000E+00	1.1050E-04	3.5000E-02	5.1890E-01
89	1.2000E+04	1.0000E+00	0.0000E+00	8.9174E-05	3.5000E-02	3.4036E-01
90	1.2200E+04	1.0000E+00	0.0000E+00	1.0199E-04	3.5000E-02	2.8312E-01
91	1.2300E+04	1.0000E+00	0.0000E+00	9.0670E-05	3.5000E-02	2.1756E-01
92	1.2700E+04	1.0000E+00	0.0000E+00	8.2683E-05	3.5000E-02	2.9169E-01
93	1.3300E+04	1.0000E+00	0.0000E+00	1.0260E-04	3.5000E-02	5.1896E-01
94	1.3600E+04	1.0000E+00	0.0000E+00	9.1473E-05	3.5000E-02	4.0887E-01
95	1.4400E+04	1.0000E+00	0.0000E+00	8.7105E-05	3.5000E-02	3.6019E-01
96	1.5000E+04	1.0000E+00	0.0000E+00	9.5262E-05	3.5000E-02	6.3045E-01
97	1.5100E+04	1.0000E+00	0.0000E+00	7.2924E-05	3.5000E-02	3.7591E-01
98	1.6400E+04	1.0000E+00	0.0000E+00	9.6541E-05	3.5000E-02	3.5699E-01
99	1.7500E+04	1.0000E+00	0.0000E+00	8.2602E-05	3.5000E-02	2.2150E-01
100	1.7600E+04	1.0000E+00	0.0000E+00	9.0441E-05	3.5000E-02	3.4094E-01
101	1.8400E+04	1.0000E+00	0.0000E+00	8.9437E-05	3.5000E-02	5.9560E-01
102	1.9200E+04	1.0000E+00	0.0000E+00	7.9165E-05	3.5000E-02	7.1276E-01
103	1.9300E+04	1.0000E+00	0.0000E+00	6.6591E-05	3.5000E-02	5.1471E-01
104	1.9900E+04	1.0000E+00	0.0000E+00	7.0721E-05	3.5000E-02	5.6137E-01
105	2.0000E+04	1.0000E+00	0.0000E+00	8.1910E-05	3.5000E-02	8.2643E-01
106	2.0200E+04	1.0000E+00	0.0000E+00	9.0913E-05	3.5000E-02	4.7857E-01
107	2.0400E+04	1.0000E+00	0.0000E+00	8.4088E-05	3.5000E-02	2.0092E-01
108	2.1000E+04	1.0000E+00	0.0000E+00	1.0104E-04	3.5000E-02	2.6345E-01
109	2.1200E+04	1.0000E+00	0.0000E+00	7.4929E-05	3.5000E-02	2.5036E-01
110	2.1700E+04	1.0000E+00	0.0000E+00	8.8157E-05	3.5000E-02	5.6047E-01
111	2.2200E+04	1.0000E+00	0.0000E+00	1.0120E-04	3.5000E-02	7.2994E-01
112	2.2300E+04	1.0000E+00	0.0000E+00	1.2651E-04	3.5000E-02	1.0014E+00
113	2.2400E+04	1.0000E+00	0.0000E+00	9.4225E-05	3.5000E-02	5.6834E-01
114	2.2800E+04	1.0000E+00	0.0000E+00	8.6872E-05	3.5000E-02	4.7216E-01
115	2.3200E+04	1.0000E+00	0.0000E+00	7.9109E-05	3.5000E-02	2.3587E-01
116	2.3400E+04	1.0000E+00	0.0000E+00	8.6298E-05	3.5000E-02	2.9940E-01
117	2.4200E+04	1.0000E+00	0.0000E+00	9.4123E-05	3.5000E-02	3.1323E-01
118	2.4400E+04	1.0000E+00	0.0000E+00	9.9763E-05	3.5000E-02	5.6908E-01
119	2.4600E+04	1.0000E+00	0.0000E+00	7.9571E-05	3.5000E-02	5.8617E-01
120	2.5000E+04	1.0000E+00	0.0000E+00	8.5593E-05	3.5000E-02	4.7128E-01

		J-VALUE	COMPETITIVE	NEUTRON	RADIATION	FISSION
DEGREES OF FREEDOM USED IN THE WIDTH DISTRIBUTION		4.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	1.0000E+00

AVERAGE RESONANCE WIDTHS (EV)

INDEX	ENERGY (EV)	LEVEL SPACING	COMPETITIVE	NEUTRON	RADIATION	FISSION
1	8.2000E+01	1.0000E+00	0.0000E+00	9.3278E-05	3.5000E-02	1.6155E-01
2	8.6500E+01	1.0000E+00	0.0000E+00	1.0334E-04	3.5000E-02	1.1690E-01
3	9.1000E+01	1.0000E+00	0.0000E+00	1.0512E-04	3.5000E-02	9.0598E-02
4	9.5500E+01	1.0000E+00	0.0000E+00	1.0681E-04	3.5000E-02	7.0703E-02
5	1.0000E+02	1.0000E+00	0.0000E+00	9.9782E-05	3.5000E-02	8.4644E-02
6	1.1000E+02	1.0000E+00	0.0000E+00	1.0764E-04	3.5000E-02	1.3140E-01
7	1.2000E+02	1.0000E+00	0.0000E+00	8.9963E-05	3.5000E-02	1.4975E-01
8	1.8000E+02	1.0000E+00	0.0000E+00	9.9277E-05	3.5000E-02	1.0195E-01
9	2.4000E+02	1.0000E+00	0.0000E+00	1.3181E-04	3.5000E-02	1.5347E-01
10	2.6000E+02	1.0000E+00	0.0000E+00	2.1003E-04	3.5000E-02	3.4367E-01
11	2.8000E+02	1.0000E+00	0.0000E+00	1.3255E-04	3.5000E-02	3.7665E-01
12	2.9000E+02	1.0000E+00	0.0000E+00	1.0049E-04	3.5000E-02	2.7955E-01
13	3.0000E+02	1.0000E+00	0.0000E+00	8.0412E-05	3.5000E-02	1.6417E-01
14	3.1500E+02	1.0000E+00	0.0000E+00	9.9316E-05	3.5000E-02	1.1021E-01
15	3.3000E+02	1.0000E+00	0.0000E+00	1.0255E-04	3.5000E-02	9.2800E-02
16	3.4500E+02	1.0000E+00	0.0000E+00	1.0536E-04	3.5000E-02	1.1411E-01
17	3.6000E+02	1.0000E+00	0.0000E+00	9.1446E-05	3.5000E-02	1.7879E-01
18	4.5000E+02	1.0000E+00	0.0000E+00	9.3835E-05	3.5000E-02	2.7583E-01
19	5.2000E+02	1.0000E+00	0.0000E+00	1.1974E-04	3.5000E-02	2.5074E-01
20	5.6500E+02	1.0000E+00	0.0000E+00	1.1742E-04	3.5000E-02	2.7107E-01
21	6.1000E+02	1.0000E+00	0.0000E+00	1.1996E-04	3.5000E-02	5.7326E-01
22	6.2000E+02	1.0000E+00	0.0000E+00	1.0825E-04	3.5000E-02	1.6382E-01
23	6.3000E+02	1.0000E+00	0.0000E+00	1.0708E-04	3.5000E-02	1.0901E-01
24	6.4000E+02	1.0000E+00	0.0000E+00	1.2153E-04	3.5000E-02	7.9341E-02
25	6.5000E+02	1.0000E+00	0.0000E+00	1.0641E-04	3.5000E-02	8.1877E-02
26	6.6000E+02	1.0000E+00	0.0000E+00	9.7168E-05	3.5000E-02	2.6137E-01
27	7.1000E+02	1.0000E+00	0.0000E+00	1.1046E-04	3.5000E-02	3.9945E-01
28	7.2500E+02	1.0000E+00	0.0000E+00	1.1895E-04	3.5000E-02	1.3883E-01
29	7.4000E+02	1.0000E+00	0.0000E+00	1.3378E-04	3.5000E-02	9.5102E-02
30	7.5500E+02	1.0000E+00	0.0000E+00	1.1936E-04	3.5000E-02	1.0876E-01
31	7.7000E+02	1.0000E+00	0.0000E+00	1.0512E-04	3.5000E-02	1.9502E-01
32	8.8000E+02	1.0000E+00	0.0000E+00	8.2353E-05	3.5000E-02	1.1204E-01
33	9.1000E+02	1.0000E+00	0.0000E+00	1.0180E-04	3.5000E-02	1.0599E-01
34	9.9000E+02	1.0000E+00	0.0000E+00	9.8780E-05	3.5000E-02	6.8540E-02
35	1.0850E+03	1.0000E+00	0.0000E+00	1.1153E-04	3.5000E-02	1.1276E-01
36	1.1800E+03	1.0000E+00	0.0000E+00	1.2142E-04	3.5000E-02	2.6837E-01
37	1.2200E+03	1.0000E+00	0.0000E+00	8.7624E-05	3.5000E-02	1.6316E-01
38	1.3000E+03	1.0000E+00	0.0000E+00	9.0564E-05	3.5000E-02	2.5191E-01
39	1.4000E+03	1.0000E+00	0.0000E+00	1.0446E-04	3.5000E-02	3.0148E-01
40	1.4300E+03	1.0000E+00	0.0000E+00	1.3656E-04	3.5000E-02	1.2372E-01
41	1.4500E+03	1.0000E+00	0.0000E+00	1.1221E-04	3.5000E-02	3.1810E-01
42	1.4600E+03	1.0000E+00	0.0000E+00	1.1391E-04	3.5000E-02	3.2326E-01
43	1.4800E+03	1.0000E+00	0.0000E+00	6.4821E-05	3.5000E-02	8.2489E-02
44	1.5000E+03	1.0000E+00	0.0000E+00	7.0660E-05	3.5000E-02	9.6713E-02
45	1.5450E+03	1.0000E+00	0.0000E+00	8.6144E-05	3.5000E-02	1.4221E-01
46	1.5900E+03	1.0000E+00	0.0000E+00	1.0195E-04	3.5000E-02	2.5717E-01
47	1.7000E+03	1.0000E+00	0.0000E+00	9.5054E-05	3.5000E-02	2.5683E-01
48	1.9000E+03	1.0000E+00	0.0000E+00	9.4274E-05	3.5000E-02	1.4587E-01
49	1.9100E+03	1.0000E+00	0.0000E+00	1.1239E-04	3.5000E-02	2.0824E-01
50	2.0000E+03	1.0000E+00	0.0000E+00	1.0774E-04	3.5000E-02	1.5741E-01
51	2.1000E+03	1.0000E+00	0.0000E+00	8.5182E-05	3.5000E-02	1.5824E-01
52	2.3000E+03	1.0000E+00	0.0000E+00	9.0730E-05	3.5000E-02	1.7292E-01
53	2.5000E+03	1.0000E+00	0.0000E+00	9.6107E-05	3.5000E-02	2.7144E-01
54	2.7000E+03	1.0000E+00	0.0000E+00	8.4700E-05	3.5000E-02	2.6558E-01
55	3.2000E+03	1.0000E+00	0.0000E+00	9.8045E-05	3.5000E-02	2.0469E-01
56	3.3000E+03	1.0000E+00	0.0000E+00	9.3389E-05	3.5000E-02	2.1984E-01
57	3.4000E+03	1.0000E+00	0.0000E+00	8.8321E-05	3.5000E-02	3.3689E-01
58	3.7500E+03	1.0000E+00	0.0000E+00	9.2666E-05	3.5000E-02	2.1118E-01
59	4.1000E+03	1.0000E+00	0.0000E+00	9.7037E-05	3.5000E-02	1.8427E-01
60	4.3000E+03	1.0000E+00	0.0000E+00	1.1061E-04	3.5000E-02	3.0196E-01
61	4.4000E+03	1.0000E+00	0.0000E+00	9.6941E-05	3.5000E-02	2.6279E-01
62	4.8000E+03	1.0000E+00	0.0000E+00	9.1578E-05	3.5000E-02	1.6573E-01
63	4.9000E+03	1.0000E+00	0.0000E+00	8.5575E-05	3.5000E-02	1.9442E-01
64	5.0000E+03	1.0000E+00	0.0000E+00	7.9647E-05	3.5000E-02	3.4059E-01
65	5.1000E+03	1.0000E+00	0.0000E+00	8.3750E-05	3.5000E-02	1.8663E-01
66	5.2000E+03	1.0000E+00	0.0000E+00	8.7799E-05	3.5000E-02	1.5042E-01
67	5.2500E+03	1.0000E+00	0.0000E+00	8.3996E-05	3.5000E-02	1.7845E-01
68	5.3000E+03	1.0000E+00	0.0000E+00	7.9635E-05	3.5000E-02	3.1054E-01
69	5.6000E+03	1.0000E+00	0.0000E+00	9.6242E-05	3.5000E-02	4.5641E-01
70	5.6500E+03	1.0000E+00	0.0000E+00	9.2935E-05	3.5000E-02	2.2832E-01
71	5.7000E+03	1.0000E+00	0.0000E+00	8.9486E-05	3.5000E-02	1.6168E-01
72	5.9000E+03	1.0000E+00	0.0000E+00	1.3332E-04	3.5000E-02	1.1659E-01
73	6.0000E+03	1.0000E+00	0.0000E+00	1.2659E-04	3.5000E-02	9.2730E-02
74	6.1000E+03	1.0000E+00	0.0000E+00	1.0003E-04	3.5000E-02	1.4748E-01
75	6.4500E+03	1.0000E+00	0.0000E+00	9.3122E-05	3.5000E-02	1.4664E-01
76	6.8000E+03	1.0000E+00	0.0000E+00	8.8171E-05	3.5000E-02	2.1271E-01
77	7.0000E+03	1.0000E+00	0.0000E+00	9.8898E-05	3.5000E-02	2.8155E-01
78	7.2000E+03	1.0000E+00	0.0000E+00	9.3412E-05	3.5000E-02	1.6993E-01
79	8.1000E+03	1.0000E+00	0.0000E+00	9.1247E-05	3.5000E-02	1.3346E-01
80	8.3000E+03	1.0000E+00	0.0000E+00	1.0663E-04	3.5000E-02	9.2010E-02
81	8.5000E+03	1.0000E+00	0.0000E+00	1.1115E-04	3.5000E-02	9.2675E-02
82	8.7000E+03	1.0000E+00	0.0000E+00	1.1565E-04	3.5000E-02	1.5094E-01
83	9.0000E+03	1.0000E+00	0.0000E+00	7.5325E-05	3.5000E-02	2.1885E-01
84	9.2000E+03	1.0000E+00	0.0000E+00	1.0652E-04	3.5000E-02	1.7662E-01
85	1.0400E+04	1.0000E+00	0.0000E+00	9.4242E-05	3.5000E-02	1.4087E-01

86	1.1400E+04	1.0000E+00	0.0000E+00	1.0069E-04	3.5000E-02	1.7440E-01
87	1.1700E+04	1.0000E+00	0.0000E+00	8.0284E-05	3.5000E-02	1.2821E-01
88	1.1900E+04	1.0000E+00	0.0000E+00	1.1050E-04	3.5000E-02	2.5945E-01
89	1.2000E+04	1.0000E+00	0.0000E+00	8.9174E-05	3.5000E-02	1.7018E-01
90	1.2200E+04	1.0000E+00	0.0000E+00	1.0199E-04	3.5000E-02	1.4156E-01
91	1.2300E+04	1.0000E+00	0.0000E+00	9.0670E-05	3.5000E-02	1.1021E-01
92	1.2700E+04	1.0000E+00	0.0000E+00	8.2683E-05	3.5000E-02	1.4535E-01
93	1.3300E+04	1.0000E+00	0.0000E+00	1.0260E-04	3.5000E-02	2.5948E-01
94	1.3600E+04	1.0000E+00	0.0000E+00	9.1473E-05	3.5000E-02	2.0443E-01
95	1.4400E+04	1.0000E+00	0.0000E+00	8.7105E-05	3.5000E-02	1.8009E-01
96	1.5000E+04	1.0000E+00	0.0000E+00	9.5262E-05	3.5000E-02	3.1601E-01
97	1.5100E+04	1.0000E+00	0.0000E+00	7.2924E-05	3.5000E-02	1.0843E-01
98	1.6400E+04	1.0000E+00	0.0000E+00	9.6541E-05	3.5000E-02	1.7850E-01
99	1.7500E+04	1.0000E+00	0.0000E+00	8.2602E-05	3.5000E-02	1.1075E-01
100	1.7600E+04	1.0000E+00	0.0000E+00	9.0441E-05	3.5000E-02	1.7047E-01
101	1.8400E+04	1.0000E+00	0.0000E+00	8.9437E-05	3.5000E-02	1.9853E-01
102	1.9200E+04	1.0000E+00	0.0000E+00	9.6110E-05	3.5000E-02	3.5630E-01
103	1.9300E+04	1.0000E+00	0.0000E+00	8.0845E-05	3.5000E-02	2.5735E-01
104	1.9900E+04	1.0000E+00	0.0000E+00	8.5859E-05	3.5000E-02	2.8068E-01
105	2.0000E+04	1.0000E+00	0.0000E+00	1.1067E-04	3.5000E-02	3.7162E-01
106	2.0200E+04	1.0000E+00	0.0000E+00	9.0913E-05	3.5000E-02	1.5932E-01
107	2.0400E+04	1.0000E+00	0.0000E+00	8.4088E-05	3.5000E-02	1.0023E-01
108	2.1000E+04	1.0000E+00	0.0000E+00	1.0104E-04	3.5000E-02	1.3143E-01
109	2.1200E+04	1.0000E+00	0.0000E+00	7.4929E-05	3.5000E-02	1.2490E-01
110	2.1700E+04	1.0000E+00	0.0000E+00	8.8157E-05	3.5000E-02	1.0682E-01
111	2.2200E+04	1.0000E+00	0.0000E+00	1.0120E-04	3.5000E-02	3.6590E-01
112	2.2300E+04	1.0000E+00	0.0000E+00	1.2651E-04	3.5000E-02	5.0199E-01
113	2.2400E+04	1.0000E+00	0.0000E+00	9.4225E-05	3.5000E-02	2.0475E-01
114	2.2800E+04	1.0000E+00	0.0000E+00	8.6872E-05	3.5000E-02	1.5739E-01
115	2.3200E+04	1.0000E+00	0.0000E+00	7.9109E-05	3.5000E-02	1.1823E-01
116	2.3400E+04	1.0000E+00	0.0000E+00	8.6298E-05	3.5000E-02	1.4970E-01
117	2.4200E+04	1.0000E+00	0.0000E+00	9.4601E-05	3.5000E-02	1.5475E-01
118	2.4400E+04	1.0000E+00	0.0000E+00	1.0027E-04	3.5000E-02	2.0116E-01
119	2.4600E+04	1.0000E+00	0.0000E+00	7.9975E-05	3.5000E-02	2.8960E-01
120	2.5000E+04	1.0000E+00	0.0000E+00	8.5593E-05	3.5000E-02	2.3508E-01

L VALUE-------------------------- 1
NUMBER OF J STATES------------ 4

DEGREES OF FREEDOM USED IN THE WIDTH DISTRIBUTION

J-VALUE	COMPETITIVE	NEUTRON	RADIATION	FISSION
2.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	2.0000E+00

AVERAGE RESONANCE WIDTHS (EV)

INDEX	ENERGY (EV)	LEVEL SPACING	COMPETITIVE	NEUTRON	RADIATION	FISSION
1	8.2000E+01	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
2	8.6500E+01	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
3	9.1000E+01	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
4	9.5500E+01	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
5	1.0000E+02	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
6	1.1000E+02	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
7	1.2000E+02	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
8	1.8000E+02	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
9	2.4000E+02	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
10	2.6000E+02	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
11	2.8000E+02	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
12	2.9000E+02	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
13	3.0000E+02	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
14	3.1500E+02	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
15	3.3000E+02	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
16	3.4500E+02	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
17	3.6000E+02	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
18	4.5000E+02	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
19	5.2000E+02	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
20	5.6500E+02	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
21	6.1000E+02	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
22	6.2000E+02	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
23	6.3000E+02	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
24	6.4000E+02	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
25	6.5000E+02	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
26	6.6000E+02	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
27	7.1000E+02	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
28	7.2500E+02	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
29	7.4000E+02	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
30	7.5500E+02	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
31	7.7000E+02	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
32	8.8000E+02	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
33	9.1000E+02	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
34	9.9000E+02	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
35	1.0850E+03	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
36	1.1800E+03	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
37	1.2200E+03	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
38	1.3000E+03	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
39	1.4000E+03	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
40	1.4300E+03	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
41	1.4500E+03	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
42	1.4600E+03	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01
43	1.4800E+03	1.1600E+00	0.0000E+00	2.3200E-04	3.5000E-02	3.3200E-01

44	1,5000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
45	1,5450E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
46	1,5900E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
47	1,7000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
48	1,9000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
49	1,9100E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
50	2,0000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
51	2,1000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
52	2,3000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
53	2,5000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
54	2,7000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
55	3,2000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
56	3,3000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
57	3,4000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
58	3,7500E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
59	4,1000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
60	4,3000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
61	4,4000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
62	4,8000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
63	4,9000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
64	5,0000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
65	5,1000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
66	5,2000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
67	5,2500E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
68	5,3000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
69	5,6000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
70	5,6500E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
71	5,7000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
72	5,9000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
73	6,0000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
74	6,1000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
75	6,4500E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
76	6,8000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
77	7,0000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
78	7,2000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
79	8,1000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
80	8,3000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
81	8,5000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
82	8,7000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
83	9,0000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
84	9,2000E+03	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
85	1,0400E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
86	1,1400E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
87	1,1700E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
88	1,1900E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
89	1,2000E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
90	1,2200E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
91	1,2300E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
92	1,2700E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
93	1,3300E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
94	1,3600E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
95	1,4400E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
96	1,5000E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
97	1,5100E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
98	1,6400E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
99	1,7500E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
100	1,7600E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
101	1,8400E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
102	1,9200E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
103	1,9300E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
104	1,9900E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
105	2,0000E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
106	2,0200E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
107	2,0400E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
108	2,1000E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
109	2,1200E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
110	2,1700E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
111	2,2200E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
112	2,2300E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
113	2,2400E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
114	2,2800E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
115	2,3200E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
116	2,3400E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
117	2,4200E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
118	2,4400E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
119	2,4600E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01
120	2,5000E+04	1.1600E+00	0,0000E+00	2,3200E-04	3.5000E-02	3,3200E-01

			DEGREES OF FREEDOM USED IN THE WIDTH DISTRIBUTION			
		J-VALUE	COMPETITIVE	NEUTRON	RADIATION	FISSION
		3.0000E+00	0.0000E+00	2.0000E+00	0.0000E+00	1.0000E+00
			AVERAGE RESONANCE WIDTHS (EV)			
INDEX	ENERGY (EV)	LEVEL SPACING	COMPETITIVE	NEUTRON	RADIATION	FISSION
1	8.2000E+01	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
2	8.6500E+01	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
3	9.1000E+01	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
4	9.5500E+01	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
5	1.0000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
6	1.1000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
7	1.2000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
8	1.8000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
9	2.4000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
10	2.6000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
11	2.8000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
12	2.9000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
13	3.0000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
14	3.1500E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
15	3.3000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
16	3.4500E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
17	3.6000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
18	4.5000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
19	5.2000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
20	5.6500E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
21	6.1000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
22	6.2000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
23	6.3000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
24	6.4000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
25	6.5000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
26	6.6000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
27	7.1000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
28	7.2500E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
29	7.4000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
30	7.5500E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
31	7.7000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
32	8.8000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
33	9.1000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
34	9.9000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
35	1.0850E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
36	1.1000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
37	1.2200E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
38	1.3000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
39	1.4000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
40	1.4300E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
41	1.4500E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
42	1.4600E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
43	1.4800E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
44	1.5000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
45	1.5450E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
46	1.5900E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
47	1.7000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
48	1.9000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
49	1.9100E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
50	2.0000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
51	2.1000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
52	2.3000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
53	2.5000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
54	2.7000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
55	3.2000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
56	3.3000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
57	3.4000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
58	3.7500E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
59	4.1000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
60	4.3000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
61	4.4000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01
62	4.8000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	1.2700E-01

63	4,9000E+03	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
64	5,0000E+03	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
65	5,1000E+03	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
66	5,2000E+03	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
67	5,2500E+03	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
68	5,3000E+03	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
69	5,6000E+03	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
70	5,6500E+03	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
71	5,7000E+03	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
72	5,9000E+03	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
73	6,0000E+03	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
74	6,1000E+03	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
75	6,4500E+03	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
76	6,8000E+03	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
77	7,0000E+03	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
78	7,2000E+03	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
79	8,1000E+03	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
80	8,3000E+03	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
81	8,5000E+03	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
82	8,7000E+03	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
83	9,0000E+03	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
84	9,2000E+03	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
85	1,0400E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
86	1,1400E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
87	1,1700E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
88	1,1900E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
89	1,2000E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
90	1,2200E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
91	1,2400E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
92	1,2700E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
93	1,3300E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
94	1,3600E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
95	1,4400E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
96	1,5000E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
97	1,5100E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
98	1,6400E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
99	1,7500E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
100	1,7600E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
101	1,8400E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
102	1,9200E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
103	1,9300E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
104	1,9900E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
105	2,0000E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
106	2,0200E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
107	2,0400E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
108	2,1000E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
109	2,1200E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
110	2,1700E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
111	2,2200E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
112	2,2300E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
113	2,2400E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
114	2,2800E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
115	2,3200E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
116	2,3400E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
117	2,4200E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
118	2,4400E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
119	2,4600E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01
120	2,5000E+04	1.0000E+00	0,0000E+00	2,0000E-04	3.5000E-02	1.2700E-01

	DEGREES OF FREEDOM USED IN THE WIDTH DISTRIBUTION			
J-VALUE	COMPETITIVE	NEUTRON	RADIATION	FISSION
4.0000E+00	0.0000E+00	2.0000E+00	0.0000E+00	2.0000E+00

			AVERAGE RESONANCE WIDTHS (EV)			
INDEX	ENERGY (EV)	LEVEL SPACING	COMPETITIVE	NEUTRON	RADIATION	FISSION
1	8.2000E+01	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
2	8.6500E+01	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
3	9.1000E+01	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
4	9.5500E+01	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
5	1.0000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
6	1.1000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
7	1.2000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
8	1.8000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
9	2.4000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
10	2.6000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
11	2.8000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
12	2.9000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
13	3.0000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
14	3.1500E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
15	3.3000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
16	3.4500E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
17	3.6000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
18	4.5000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
19	5.2000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
20	5.6500E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
21	6.1000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
22	6.2000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
23	6.3000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
24	6.4000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
25	6.5000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
26	6.6000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
27	7.1000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
28	7.2500E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
29	7.4000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
30	7.5500E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
31	7.7000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
32	8.8000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
33	9.1000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
34	9.9000E+02	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
35	1.0850E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
36	1.1800E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
37	1.2200E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
38	1.3000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
39	1.4000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
40	1.4300E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
41	1.4500E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
42	1.4600E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
43	1.4800E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
44	1.5000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
45	1.5450E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
46	1.5900E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
47	1.7000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
48	1.9000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
49	1.9100E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
50	2.0000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
51	2.1000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
52	2.3000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
53	2.5000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
54	2.7000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
55	3.2000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
56	3.3000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
57	3.4000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
58	3.7500E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
59	4.1000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
60	4.3000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
61	4.4000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
62	4.8000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
63	4.9000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
64	5.0000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
65	5.1000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
66	5.2000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
67	5.2500E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
68	5.3000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
69	5.6000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
70	5.6500E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
71	5.7000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
72	5.9000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
73	6.0000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
74	6.1000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
75	6.4500E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
76	6.8000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
77	7.0000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
78	7.2000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
79	8.1000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
80	8.3000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
81	8.5000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
82	8.7000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
83	9.0000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
84	9.2000E+03	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
85	1.0400E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
86	1.1400E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01

87	1.1700E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
88	1.1900E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
89	1.2000E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
90	1.2200E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
91	1.2300E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
92	1.2700E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
93	1.3300E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
94	1.3600E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
95	1.4400E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
96	1.5000E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
97	1.5100E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
98	1.6400E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
99	1.7500E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
100	1.7600E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
101	1.8400E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
102	1.9200E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
103	1.9300E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
104	1.9900E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
105	2.0000E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
106	2.0200E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
107	2.0400E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
108	2.1000E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
109	2.1200E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
110	2.1700E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
111	2.2200E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
112	2.2300E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
113	2.2400E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
114	2.2800E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
115	2.3200E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
116	2.3400E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
117	2.4200E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
118	2.4400E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
119	2.4600E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01
120	2.5000E+04	1.0000E+00	0.0000E+00	2.0000E-04	3.5000E-02	2.8600E-01

DEGREES OF FREEDOM USED IN THE WIDTH DISTRIBUTION

J-VALUE	COMPETITIVE	NEUTRON	RADIATION	FISSION
5.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	1.0000E+00

AVERAGE RESONANCE WIDTHS (EV)

INDEX	ENERGY (EV)	LEVEL SPACING	COMPETITIVE	NEUTRON	RADIATION	FISSION
1	8.2000E+01	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
2	8.6500E+01	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
3	9.1000E+01	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
4	9.5500E+01	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
5	1.0000E+02	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
6	1.1000E+02	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
7	1.2000E+02	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
8	1.8000E+02	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
9	2.4000E+02	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
10	2.6000E+02	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
11	2.8000E+02	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
12	2.9000E+02	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
13	3.0000E+02	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
14	3.1500E+02	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
15	3.3000E+02	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
16	3.4500E+02	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
17	3.6000E+02	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
18	4.5000E+02	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
19	5.2000E+02	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
20	5.6500E+02	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
21	6.1000E+02	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
22	6.2000E+02	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
23	6.3000E+02	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
24	6.4000E+02	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
25	6.5000E+02	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
26	6.6000E+02	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
27	7.1000E+02	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
28	7.2500E+02	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
29	7.4000E+02	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
30	7.5500E+02	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
31	7.7000E+02	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
32	8.8000E+02	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
33	9.1000E+02	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
34	9.9000E+02	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
35	1.0850E+03	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
36	1.1800E+03	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
37	1.2200E+03	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
38	1.3000E+03	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
39	1.4000E+03	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
40	1.4300E+03	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
41	1.4500E+03	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
42	1.4600E+03	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
43	1.4800E+03	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01
44	1.5000E+03	1.1200E+00	0.0000E+00	2.2400E-04	3.5000E-02	1.4300E-01

45	1,5450E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
46	1,5900E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
47	1,7000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
48	1,9000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
49	1,9100E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
50	2,0000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
51	2,1000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
52	2,3000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
53	2,5000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
54	2,7000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
55	3,2000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
56	3,3000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
57	3,4000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
58	3,7500E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
59	4,1000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
60	4,3000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
61	4,4000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
62	4,8000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
63	4,9000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
64	5,0000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
65	5,1000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
66	5,2000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
67	5,2500E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
68	5,3000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
69	5,6000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
70	5,6500E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
71	5,7000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
72	5,9000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
73	6,0000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
74	6,1000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
75	6,4500E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
76	6,8000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
77	7,0000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
78	7,2000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
79	8,1000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
80	8,3000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
81	8,5000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
82	8,7000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
83	9,0000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
84	9,2000E+03	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
85	1,0400E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
86	1,1400E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
87	1,1700E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
88	1,1900E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
89	1,2000E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
90	1,2200E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
91	1,2300E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
92	1,2700E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
93	1,3300E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
94	1,3600E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
95	1,4400E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
96	1,5000E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
97	1,5100E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
98	1,6400E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
99	1,7500E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
100	1,7600E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
101	1,8400E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
102	1,9200E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
103	1,9300E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
104	1,9900E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
105	2,0000E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
106	2,0200E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
107	2,0400E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
108	2,1000E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
109	2,1200E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
110	2,1700E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
111	2,2200E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
112	2,2300E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
113	2,2400E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
114	2,2800E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
115	2,3200E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
116	2,3400E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
117	2,4200E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
118	2,4400E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
119	2,4600E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01
120	2,5000E+04	1.1200E+00	0,0000E+00	2,2400E-04	3.5000E-02	1.4300E-01

URANIUM-235 FISSION NEUTRON CROSS SECTION ENDF/B MATERIAL NO. 6261

REACTION Q VALUE 1,9250E+08 EV

INTERPOLATION LAW BETWEEN ENERGIES

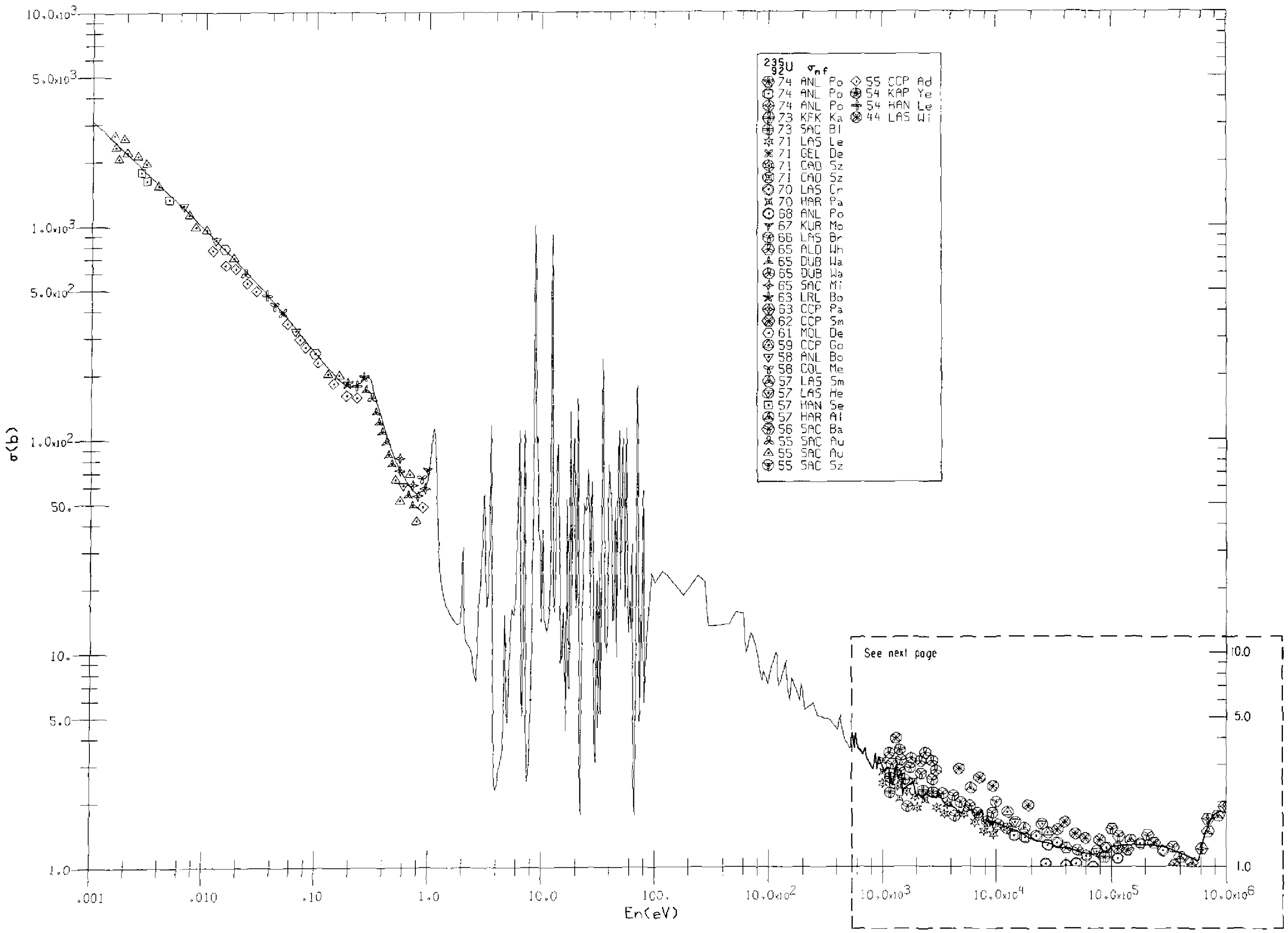
RANGE	DESCRIPTION	RANGE	DESCRIPTION	RANGE	DESCRIPTION
1 TO 57	LN Y LINEAR IN LN X	57 TO 478	Y LINEAR IN X	478 TO 810	Y LINEAR IN LN X

NEUTRON CROSS SECTIONS

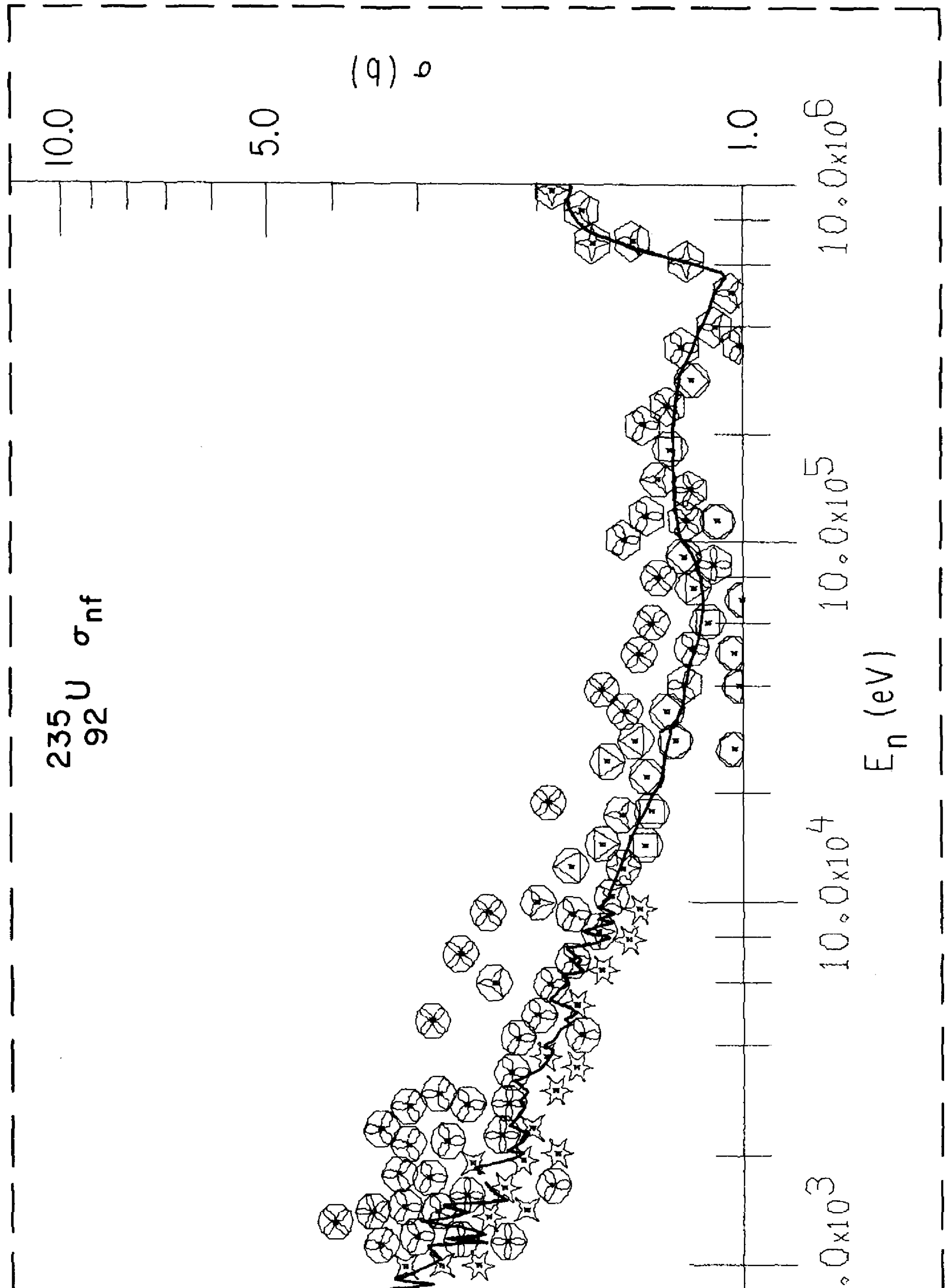
INDEX,	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	1,0000E-05	3,1310E+04	1,0000E-03	3,1234E+03	5,0000E-03	1,3832E+03	1,0000E-02	9.6623E+02	1,5000E-02	7,7939E+02
6	2,0000E-02	6,6687E+02	2,5300E-02	5,8540E+02	3,0000E-02	5,3159E+02	3,5000E-02	4.8633E+02	4,0000E-02	4,4961E+02
11	4,5000E-02	4,1898E+02	5,0000E-02	3,9201E+02	5,5000E-02	3,7039E+02	6,0000E-02	3.5069E+02	6,5000E-02	3,3330E+02
16	7,0000E-02	3,1784E+02	7,5000E-02	3,0405E+02	8,0000E-02	2,9175E+02	8,5000E-02	2.8072E+02	9,0000E-02	2,7072E+02
21	9,5000E-02	2,6159E+02	1,0000E-01	2,5329E+02	1,1000E-01	2,3822E+02	1,2000E-01	2.2525E+02	1,3000E-01	2,1413E+02
26	1,4000E-01	2,0486E+02	1,5000E-01	1,9726E+02	1,6000E-01	1,9082E+02	1,7000E-01	1.8561E+02	1,8000E-01	1,8158E+02
31	2,0334E-01	1,7701E+02	2,2334E-01	1,7795E+02	2,4334E-01	1,8385E+02	2,6334E-01	1.9140E+02	2,8334E-01	1,9642E+02
36	3,0334E-01	1,9182E+02	3,2334E-01	1,7425E+02	3,4334E-01	1,5394E+02	3,6334E-01	1.3901E+02	3,8334E-01	1,2603E+02
41	4,0334E-01	1,1516E+02	4,2812E-01	1,0406E+02	4,6492E-01	9,1586E+01	5,0492E-01	8.1960E+01	5,4492E-01	7,4805E+01
46	5,8492E-01	6,9431E+01	6,2492E-01	6,5391E+01	6,6492E-01	6,2223E+01	7,0492E-01	5.9661E+01	7,4492E-01	5,7651E+01
51	7,8492E-01	5,6285E+01	8,2492E-01	5,5659E+01	8,6492E-01	5,5983E+01	9,0492E-01	5.7644E+01	9,4492E-01	6,0738E+01
56	9,8492E-01	6,5238E+01	1,0000E+00	6,8116E+01	1,0000E+00	1,1856E+01	1.0550E+00	1.1430E+01	1,0730E+00	1,0640E+01
61	1,0910E+00	9,2900E+00	1,1820E+00	-1,9290E+01	1,2000E+00	-2,3570E+01	1,2180E+00	-2.5000E+01	1,2360E+00	-2,5000E+01
66	1,3270E+00	-1,4290E+01	1,3640E+00	-1,2140E+01	1,4550E+00	-8,2100E+00	1.5450E+00	-6.0700E+00	1,6360E+00	-4,6400E+00
71	1,7270E+00	-3,5700E+00	1,8180E+00	-2,8600E+00	1,9090E+00	-2,1400E+00	2,0000E+00	-2.1400E+00	2,1820E+00	-1,4300E+00
76	2,3640E+00	-7,1000E-01	2,4550E+00	-1,0700E+00	2,5450E+00	-1,7900E+00	2.6360E+00	-3.5700E+00	2,6910E+00	-4,2900E+00
81	2,7450E+00	-4,2900E+00	2,8000E+00	0,0000E+00	2,8180E+00	7,1000E-01	2.8550E+00	7.1000E-01	2,9270E+00	-7,1000E-01
86	2,9450E+00	-7,1000E-01	3,0180E+00	3,5700E+00	3,0720E+00	3,5700E+00	3.1820E+00	-3.5700E+00	3,2180E+00	-3,2100E+00
91	3,2730E+00	-1,4300E+00	3,3640E+00	2,1400E+00	3,4550E+00	6,5000E+00	3.4910E+00	7.1000E+00	3,5450E+00	8,0000E+00
96	3,5820E+00	2,5000E+00	3,6360E+00	0,0000E+00	3,6910E+00	-6,9800E+00	3.7270E+00	-9.1900E+00	3,8180E+00	-7,1400E+00
101	3,9090E+00	-5,3600E+00	4,0000E+00	-4,4000E+00	4,0910E+00	-3,7000E+00	4.1820E+00	-3.1400E+00	4,3640E+00	-2,2900E+00
106	4,5450E+00	-2,1400E+00	4,6360E+00	-1,7900E+00	4,7270E+00	-1,4300E+00	4.7820E+00	0.0000E+00	4,8000E+00	7,1000E-01
111	4,8360E+00	7,1000E-01	4,8550E+00	7,1000E-01	4,8910E+00	-1,4300E+00	4.9090E+00	-2.1400E+00	4,9450E+00	-2,8600E+00
116	4,9810E+00	-2,8600E+00	5,0910E+00	-2,8600E+00	5,1450E+00	-2,5000E+00	5.1820E+00	-2.1400E+00	5,2730E+00	-1,0700E+00
121	5,3090E+00	-7,1000E-01	5,5450E+00	-7,1000E-01	5,6550E+00	-1,7900E+00	5.7270E+00	-1.4300E+00	5,8180E+00	0.0000E+00
126	5,9090E+00	1,6400E+00	6,0000E+00	2,8600E+00	6,0910E+00	2,5000E+00	6.1640E+00	1.4300E+00	6,2180E+00	-1,7900E+00
131	6,2550E+00	-1,7900E+00	6,2910E+00	0,0000E+00	6,4180E+00	0,0000E+00	6.4550E+00	-2.8600E+00	6,4910E+00	-5,0000E+00
136	6,5450E+00	-5,0000E+00	6,6360E+00	-4,2800E+00	6,7270E+00	-3,7100E+00	6.8180E+00	-2.1400E+00	6,9820E+00	0,0000E+00
141	7,1820E+00	0,0000E+00	7,2910E+00	-3,5700E+00	7,8180E+00	-3,9300E+00	8.0000E+00	-4.2900E+00	8,1810E+00	-4,2900E+00
146	8,3630E+00	-3,9300E+00	8.4530E+00	0,0000E+00	8,9250E+00	0,0000E+00	9,0150E+00	2.1430E+01	9,0520E+00	2,5000E+01
151	9,1060E+00	2,5000E+01	9,1790E+00	1,0000E+01	9,2330E+00	0,0000E+00	9.3600E+00	0.0000E+00	9,4320E+00	1,0000E+01
156	9,4910E+00	1,1430E+01	9,5050E+00	1,0000E+01	9,5410E+00	8,2100E+00	9.7040E+00	0.0000E+00	9,7590E+00	-2,1400E+00
161	9,9950E+00	-2,1400E+00	1,0085E+01	-2,8600E+00	1,0176E+01	0,0000E+00	1.0267E+01	0.0000E+00	1,0339E+01	2,1400E+00
166	1,0430E+01	2,1400E+00	1,0629E+01	-7,1000E-01	1,0720E+01	-7,1000E-01	1.0811E+01	-3.6000E-01	1,0937E+01	-5,7000E-01
171	1,0992E+01	0,0000E+00	1,1264E+01	3,0000E+00	1,1409E+01	2,7500E+00	1.1445E+01	2.8800E+00	1,1481E+01	2,9000E+00
176	1,1854E+01	0,0000E+00	1,1862E+01	0,0000E+00	1,1898E+01	2,7000E+00	1.2000E+01	5.4000E+00	1,2091E+01	7,4300E+00
181	1,2145E+01	1,1350E+01	1,2200E+01	1,0000E+01	1,2350E+01	0,0000E+00	1.4085E+01	0.0000E+00	1,4267E+01	2,8600E+00
186	1,4357E+01	5,7100E+00	1,4412E+01	5,7100E+00	1,4448E+01	4,7100E+00	1.4611E+01	-5.5000E+00	1,4647E+01	-5,5000E+00
191	1,4737E+01	-3,5700E+00	1,4901E+01	-5,0000E-01	1,5000E+01	-7,1000E-01	1.5091E+01	0.0000E+00	1,5182E+01	7,1000E-01
196	1,5273E+01	0,0000E+00	1,5455E+01	0,0000E+00	1,5545E+01	-1,4300E+00	1.5636E+01	-3.5800E+00	1,5727E+01	-3,5700E+00
201	1,5818E+01	-2,5000E+00	1,5909E+01	-1,2100E+00	1,6000E+01	0,0000E+00	1.6182E+01	0.0000E+00	1,6273E+01	-3,5800E+00
206	1,6364E+01	-6,4500E+00	1,6436E+01	-6,4300E+00	1,6491E+01	-6,4300E+00	1.6545E+01	-4.2900E+00	1,6636E+01	0,0000E+00
211	1,6727E+01	0,0000E+00	1,6818E+01	1,4300E+00	1,6909E+01	3,9300E+00	1.6945E+01	4.2900E+00	1,7000E+01	3,5700E+00
216	1,7091E+01	2,8600E+00	1,7181E+01	1,4300E+00	1,7273E+01	7,1000E-01	1.7364E+01	0.0000E+00	1,7455E+01	0,0000E+00
221	1,7545E+01	-7,1000E-01	1.7636E+01	-1,0700E+00	1,7727E+01	-1,4300E+00	1.7818E+01	-1.8600E+00	1,7909E+01	-7,1000E-01
226	1,8091E+01	0,0000E+00	1,8273E+01	0,0000E+00	1,8364E+01	3,5700E+00	1.8455E+01	3.9300E+00	1,8545E+01	3,5700E+00
231	1,8636E+01	2,8600E+00	1,8727E+01	2,1400E+00	1,8818E+01	1,4300E+00	1.8909E+01	1.0700E+00	1,9000E+01	0,0000E+00
236	1,9381E+01	0,0000E+00	1,9436E+01	2,8600E+00	1,9455E+01	7,1400E+00	1.9491E+01	1.4290E+01	1,9509E+01	1,7140E+01
241	1,9527E+01	1,7140E+01	1,9545E+01	1,5710E+01	1,9618E+01	1,0710E+01	1.9672E+01	8.2900E+00	1,9727E+01	6.4300E+00

246	1.9818E+01	4.2900E+00	1.9909E+01	2.5000E+00	2.0000E+01	7.1000E-01	2.0091E+01	0.0000E+00	2.0273E+01	-7.1000E-01
251	2.0909E+01	-7.1000E-01	2.1000E+01	-7.1000E-01	2.1036E+01	-1.0000E+00	2.1091E+01	-1.0000E+00	2.1127E+01	-1.1000E+00
256	2.1182E+01	-1.2000E+00	2.1218E+01	-1.3000E+00	2.1264E+01	-1.3500E+00	2.1364E+01	-1.4300E+00	2.1400E+01	-2.1500E+00
261	2.1455E+01	-2.1500E+00	2.1545E+01	-2.8000E+00	2.1727E+01	-3.4500E+00	2.1909E+01	-2.8700E+00	2.2091E+01	-2.5100E+00
266	2.2273E+01	-1.7900E+00	2.2455E+01	-1.0700E+00	2.2636E+01	0.0000E+00	2.3000E+01	0.0000E+00	2.3115E+01	4.0000E-01
271	2.3230E+01	3.6000E-01	2.3460E+01	1.8000E-01	2.3690E+01	9.0000E-02	2.3874E+01	0.0000E+00	2.4011E+01	-4.6400E+00
276	2.4103E+01	-4.6500E+00	2.4379E+01	2.7300E+00	2.4609E+01	9.0000E+00	2.4839E+01	4.6400E+00	2.5069E+01	-4.5000E-01
281	2.5161E+01	-4.5000E-01	2.5345E+01	1.8200E+00	2.5529E+01	0.0000E+00	2.5713E+01	0.0000E+00	2.5851E+01	-4.5500E+00
286	2.6034E+01	-1.0910E+01	2.6126E+01	-1.0910E+01	2.6218E+01	-7.7300E+00	2.6448E+01	0.0000E+00	2.8425E+01	0.0000E+00
291	2.8517E+01	4.5000E-01	2.8747E+01	4.5000E-01	2.8977E+01	4.5000E-01	2.9207E+01	4.5000E-01	2.9437E+01	4.5000E-01
296	2.9667E+01	0.0000E+00	2.9897E+01	-1.8000E-01	3.0000E+01	-3.6000E-01	3.0229E+01	-4.5000E-01	3.0457E+01	0.0000E+00
301	3.0686E+01	0.0000E+00	3.0777E+01	0.0000E+00	3.0914E+01	0.0000E+00	3.0960E+01	-8.2000E-01	3.1097E+01	-2.1800E+00
306	3.1143E+01	-2.3600E+00	3.1371E+01	-1.8200E+00	3.1600E+01	-9.1000E-01	3.1691E+01	-7.3000E-01	3.1829E+01	0.0000E+00
311	3.2199E+01	0.0000E+00	3.2286E+01	0.0000E+00	3.2514E+01	-2.7300E+00	3.2743E+01	-3.1800E+00	3.2971E+01	-3.1800E+00
316	3.3200E+01	-2.2700E+00	3.3520E+01	0.0000E+00	3.4434E+01	0.0000E+00	3.4480E+01	2.7270E+01	3.4526E+01	3.2730E+01
321	3.4571E+01	3.3630E+01	3.4617E+01	2.9090E+01	3.4663E+01	1.6360E+01	3.4709E+01	8.1800E+00	3.4754E+01	4.5400E+00
326	3.4846E+01	0.0000E+00	3.6629E+01	0.0000E+00	3.6857E+01	-9.1000E-01	3.7086E+01	-1.5000E+00	3.7314E+01	0.0000E+00
331	3.7543E+01	7.3000E-01	3.7771E+01	9.1000E-01	3.8000E+01	8.2000E-01	3.8229E+01	7.3000E-01	3.8457E+01	5.5000E-01
336	3.8686E+01	-3.6000E-01	3.8914E+01	-2.1800E+00	3.9143E+01	-4.5500E+00	3.9234E+01	-5.0000E+00	3.9280E+01	0.0000E+00
341	3.9960E+01	0.0000E+00	4.0194E+01	-1.8200E+00	4.0514E+01	0.0000E+00	4.0697E+01	2.7200E+00	4.0743E+01	3.4500E+00
346	4.0789E+01	3.6400E+00	4.0971E+01	2.7300E+00	4.1200E+01	0.0000E+00	4.1566E+01	0.0000E+00	4.1657E+01	-9.1000E-01
351	4.1794E+01	-9.1000E-01	4.1977E+01	2.7300E+00	4.2114E+01	1.8200E+00	4.2297E+01	0.0000E+00	4.2389E+01	2.7300E+00
356	4.2571E+01	2.7300E+00	4.2709E+01	-9.1000E-01	4.2800E+01	-9.1000E-01	4.2891E+01	1.8200E+00	4.3029E+01	1.8200E+00
361	4.3211E+01	0.0000E+00	4.3669E+01	0.0000E+00	4.3806E+01	-1.8200E+00	4.4034E+01	1.8200E+00	4.4171E+01	2.2700E+00
366	4.4400E+01	1.6400E+00	4.4629E+01	0.0000E+00	4.4857E+01	-1.8000E-01	4.5086E+01	0.0000E+00	4.5314E+01	-6.3000E-01
371	4.5543E+01	-5.5000E-01	4.5771E+01	-7.3000E-01	4.6000E+01	-1.0000E+00	4.6181E+01	-1.4300E+00	4.6363E+01	-7.1000E-01
376	4.6544E+01	0.0000E+00	4.7270E+01	0.0000E+00	4.7451E+01	7.2000E-01	4.7633E+01	2.1400E+00	4.7741E+01	2.7100E+00
381	4.7887E+01	0.0000E+00	4.9011E+01	0.0000E+00	4.9120E+01	2.8600E+00	4.9193E+01	2.8600E+00	4.9338E+01	0.0000E+00
386	4.9556E+01	0.0000E+00	4.9664E+01	2.1400E+00	4.9773E+01	2.1400E+00	4.9955E+01	0.0000E+00	5.3438E+01	0.0000E+00
391	5.3619E+01	2.8600E+00	5.3800E+01	3.5700E+00	5.4000E+01	1.4300E+00	5.4181E+01	0.0000E+00	5.5995E+01	0.0000E+00
396	5.6177E+01	5.0000E+00	5.6286E+01	7.8600E+00	5.6358E+01	5.0000E+00	5.6431E+01	0.0000E+00	5.6649E+01	0.0000E+00
401	5.6794E+01	5.0000E+00	5.6902E+01	2.8600E+00	5.7120E+01	-7.1000E-01	5.7265E+01	-1.2900E+00	5.7628E+01	-1.2900E+00
406	5.7810E+01	0.0000E+00	5.7991E+01	0.0000E+00	5.8172E+01	0.0000E+00	5.8317E+01	-2.5000E+00	5.8390E+01	-2.0000E+00
411	5.8825E+01	0.0000E+00	5.9007E+01	1.4000E+00	5.9116E+01	1.4000E+00	5.9442E+01	7.0000E-01	5.9624E+01	3.5000E-01
416	5.9805E+01	0.0000E+00	6.9400E+01	0.0000E+00	6.9619E+01	3.0000E+00	6.9800E+01	4.1000E+00	7.0000E+01	4.1400E+00
421	7.0181E+01	0.0000E+00	7.1560E+01	0.0000E+00	7.1814E+01	-2.8600E+00	7.1923E+01	-3.9300E+00	7.1995E+01	-3.9300E+00
426	7.2068E+01	-3.5700E+00	7.2104E+01	-2.1400E+00	7.2177E+01	0.0000E+00	7.2322E+01	0.0000E+00	7.2503E+01	0.0000E+00
431	7.2685E+01	6.7900E+00	7.2721E+01	4.0000E+00	7.2830E+01	1.4000E+00	7.2902E+01	3.6000E-01	7.2975E+01	0.0000E+00
436	7.3084E+01	0.0000E+00	7.3991E+01	0.0000E+00	7.4426E+01	0.0000E+00	7.4571E+01	3.5700E+00	7.4789E+01	1.6790E+01
441	7.4825E+01	1.6790E+01	7.4862E+01	1.4290E+01	7.4898E+01	9.2900E+00	7.4934E+01	7.5000E+00	7.4971E+01	5.7100E+00
446	7.5043E+01	3.2100E+00	7.5079E+01	2.1400E+00	7.5188E+01	0.0000E+00	7.6023E+01	-1.0000E+00	7.6168E+01	-1.2000E+00
451	7.6748E+01	0.0000E+00	7.8300E+01	0.0000E+00	7.8363E+01	5.0000E+00	7.8544E+01	6.1000E+00	7.8726E+01	5.0000E+00
456	7.8907E+01	4.5000E+00	7.9088E+01	3.2000E+00	7.9270E+01	2.1400E+00	7.9451E+01	0.0000E+00	7.9814E+01	0.0000E+00
461	7.9995E+01	2.3200E+00	8.0068E+01	2.3200E+00	8.0249E+01	0.0000E+00	8.0467E+01	0.0000E+00	8.0757E+01	2.0000E+00
466	8.0860E+01	2.1000E+00	8.0975E+01	2.0000E+00	8.1084E+01	1.5000E+00	8.1338E+01	0.0000E+00	8.1519E+01	0.0000E+00
471	8.1628E+01	0.0000E+00	8.1810E+01	1.5000E+00	8.2000E+01	1.5000E+00	8.2000E+01	0.0000E+00	1.0000E+03	0.0000E+00
476	1.3000E+04	0.0000E+00	2.5000E+04	0.0000E+00	2.5000E+04	2.1522E+00	2.5300E+04	2.1398E+00	2.5700E+04	2.1235E+00
481	2.6200E+04	2.1073E+00	2.6500E+04	2.1011E+00	2.7200E+04	2.0931E+00	2.7500E+04	2.0961E+00	2.8300E+04	2.1353E+00
486	2.8800E+04	2.1913E+00	2.9300E+04	2.1608E+00	2.9800E+04	2.0742E+00	3.0000E+04	2.0400E+00	3.1100E+04	2.0830E+00
491	3.1300E+04	2.1077E+00	3.1800E+04	2.1688E+00	3.2100E+04	2.1775E+00	3.2500E+04	2.1159E+00	3.2800E+04	2.0702E+00
496	3.4200E+04	1.9888E+00	3.4500E+04	1.9580E+00	3.5000E+04	1.9074E+00	3.6200E+04	1.9825E+00	3.6500E+04	1.9272E+00
501	3.7000E+04	1.8360E+00	3.7900E+04	1.9463E+00	3.8700E+04	1.8939E+00	3.9100E+04	1.8687E+00	3.9400E+04	1.8748E+00
506	4.0000E+04	1.8870E+00	4.0400E+04	1.9445E+00	4.1000E+04	2.0298E+00	4.1500E+04	1.9580E+00	4.2000E+04	1.8870E+00
511	4.3000E+04	1.9176E+00	4.3600E+04	1.9053E+00	4.3800E+04	1.9012E+00	4.4300E+04	1.8818E+00	4.4800E+04	1.8563E+00
516	4.5000E+04	1.8462E+00	4.5200E+04	1.8338E+00	4.5400E+04	1.8216E+00	4.6000E+04	1.7850E+00	4.6200E+04	1.8015E+00
521	4.6500E+04	1.8260E+00	4.6800E+04	1.8504E+00	4.7300E+04	1.8327E+00	4.7600E+04	1.7990E+00	4.8200E+04	1.7688E+00
526	4.8400E+04	1.7831E+00	4.8800E+04	1.8116E+00	4.9000E+04	1.8258E+00	5.0000E+04	1.7442E+00	5.0200E+04	1.7545E+00
531	5.0600E+04	1.7749E+00	5.0900E+04	1.7901E+00	5.1200E+04	1.7952E+00	5.1500E+04	1.7952E+00	5.2200E+04	1.8219E+00
536	5.2500E+04	1.8618E+00	5.3500E+04	1.9227E+00	5.3900E+04	1.9186E+00	5.4200E+04	1.9176E+00	5.4600E+04	1.9176E+00
541	5.5000E+04	1.9176E+00	5.5300E+04	1.9145E+00	5.5700E+04	1.9104E+00	5.6100E+04	1.9023E+00	5.6700E+04	1.8716E+00
546	5.7100E+04	1.8595E+00	5.7600E+04	1.8748E+00	5.7900E+04	1.8840E+00	5.8300E+04	1.8654E+00	5.8700E+04	1.8369E+00

551	5,9100E+04	1,8115E+00	5,9200E+04	1.8074E+00	5,9800E+04	1,7829E+00	6.0000E+04	1.7748E+00	6,0300E+04	1.8056E+00
556	6,1200E+04	1,8624E+00	6,1500E+04	1,8410E+00	6,2000E+04	1,8054E+00	6.2500E+04	1.8156E+00	6,2900E+04	1.8238E+00
561	6,3200E+04	1,8320E+00	6.4200E+04	1.8277E+00	6,4700E+04	1,7562E+00	6.5000E+04	1.7136E+00	6,5100E+04	1,7228E+00
566	6,6100E+04	1,8013E+00	6,6500E+04	1.7849E+00	6,7000E+04	1,7646E+00	6,7400E+04	1.7892E+00	6,8000E+04	1.8258E+00
571	6,8300E+04	1.8043E+00	6,8900E+04	1.7615E+00	6,9400E+04	1,7462E+00	7,0000E+04	1.7340E+00	7,0300E+04	1,7340E+00
576	7,0900E+04	1.7340E+00	7,2000E+04	1.7340E+00	7,2500E+04	1,7801E+00	7,3100E+04	1.8217E+00	7,3700E+04	1.7972E+00
581	7,4100E+04	1,7901E+00	7,4800E+04	1.8259E+00	7,5000E+04	1,8360E+00	7,5300E+04	1,8237E+00	7,5800E+04	1.8033E+00
586	7,6500E+04	1,7236E+00	7,7000E+04	1.6524E+00	7,7600E+04	1,6892E+00	7,8400E+04	1,7218E+00	7,8900E+04	1.7320E+00
591	7,9400E+04	1.6685E+00	8,0000E+04	1.5708E+00	8,0700E+04	1,6566E+00	8.2000E+04	1.7136E+00	8,2700E+04	1.6921E+00
596	8,3300E+04	1,6492E+00	8,4000E+04	1.5708E+00	8,4700E+04	1,6638E+00	8.5000E+04	1.7034E+00	8,5300E+04	1,6604E+00
601	8,6100E+04	1.5544E+00	8,6800E+04	1.5116E+00	8,7500E+04	1,5557E+00	8,8300E+04	1.5932E+00	8,9000E+04	1,5504E+00
606	9,0000E+04	1.6320E+00	9,0300E+04	1.6320E+00	9,1200E+04	1,5910E+00	9,2800E+04	1.5260E+00	9,3600E+04	1.5749E+00
611	9,4400E+04	1.5789E+00	9,5000E+04	1.5606E+00	9,5200E+04	1,5749E+00	9,6000E+04	1.6320E+00	9,6800E+04	1,7055E+00
616	9,7700E+04	1.6308E+00	9,8500E+04	1.6270E+00	9,9300E+04	1,6534E+00	9,9900E+04	1.6350E+00	1,0000E+05	1.5850E+00
621	1,0300E+05	1.5720E+00	1,2000E+05	1.5320E+00	1,3500E+05	1,4960E+00	1.4000E+05	1.4820E+00	1,5000E+05	1.4580E+00
626	1,6000E+05	1.4400E+00	1,7300E+05	1.4070E+00	1,8000E+05	1,3940E+00	2.0000E+05	1.3510E+00	2,0700E+05	1.3350E+00
631	2,1500E+05	1,3262E+00	2,2000E+05	1.3218E+00	2,2500E+05	1,3177E+00	2.3500E+05	1.3123E+00	2,4000E+05	1.3100E+00
636	2,5000E+05	1.3075E+00	2,6000E+05	1.3037E+00	2,7000E+05	1,3000E+00	2.8000E+05	1.2953E+00	3,0000E+05	1.2800E+00
641	3,2000E+05	1,2440E+00	3,2500E+05	1,2378E+00	3,4000E+05	1,2288E+00	3.5000E+05	1,2262E+00	3,6000E+05	1,2233E+00
646	3,8000E+05	1.2210E+00	4,0000E+05	1.2163E+00	4,2000E+05	1,2098E+00	4.4000E+05	1.2013E+00	4,5000E+05	1,1960E+00
651	4,6000E+05	1,1900E+00	4,7000E+05	1.1848E+00	4,8000E+05	1,1798E+00	5,0000E+05	1.1717E+00	5,2000E+05	1,1640E+00
656	5,4000E+05	1,1585E+00	5,5000E+05	1,1575E+00	5,6000E+05	1,1562E+00	5.7000E+05	1,1549E+00	5,8000E+05	1,1538E+00
661	6,0000E+05	1,1525E+00	6,2000E+05	1,1488E+00	6,4000E+05	1,1451E+00	6,5000E+05	1,1436E+00	6,6000E+05	1,1424E+00
666	6,7000E+05	1,1405E+00	6,8000E+05	1.1387E+00	7,0000E+05	1,1350E+00	7.2000E+05	1,1303E+00	7,3000E+05	1,1288E+00
671	7,4000E+05	1,1281E+00	7,5000E+05	1,1278E+00	7,6000E+05	1,1281E+00	7,7000E+05	1,1293E+00	7,7500E+05	1,1298E+00
676	7,8000E+05	1,1300E+00	8,0000E+05	1,1330E+00	8,2000E+05	1,1397E+00	8.4000E+05	1,1460E+00	8,5000E+05	1,1512E+00
681	8,6000E+05	1,1603E+00	8,8000E+05	1,1640E+00	9,0000E+05	1,1738E+00	9.2000E+05	1,1838E+00	9,4000E+05	1,1938E+00
686	9,5000E+05	1,1987E+00	9,6000E+05	1,2040E+00	9,7000E+05	1,2100E+00	9.8000E+05	1,2150E+00	1,0000E+06	1,2250E+00
691	1,0500E+06	1.2410E+00	1,1000E+06	1.2500E+00	1,1500E+06	1,2551E+00	1,2000E+06	1,2575E+00	1,2500E+06	1,2566E+00
696	1,2950E+06	1.2550E+00	1.3000E+06	1.2549E+00	1,3500E+06	1,2522E+00	1,4000E+06	1.2500E+00	1,4500E+06	1,2490E+00
701	1,4950E+06	1,2495E+00	1.5000E+06	1,2505E+00	1,6000E+06	1,2575E+00	1.7000E+06	1,2628E+00	1,8000E+06	1,2670E+00
706	1,9000E+06	1,2715E+00	2,0000E+06	1,2740E+00	2,1000E+06	1,2768E+00	2,2000E+06	1,2788E+00	2,3000E+06	1,2793E+00
711	2,4000E+06	1,2788E+00	2,5000E+06	1,2754E+00	2,6000E+06	1,2688E+00	2,7000E+06	1,2600E+00	2,8000E+06	1,2512E+00
716	2,9000E+06	1,2412E+00	3,0000E+06	1,2318E+00	3,1000E+06	1,2218E+00	3.2000E+06	1,2113E+00	3,3000E+06	1,2014E+00
721	3,4000E+06	1,1920E+00	3,5000E+06	1,1830E+00	3,6000E+06	1,1770E+00	3,7000E+06	1,1710E+00	3,8000E+06	1,1620E+00
726	3,9000E+06	1,1580E+00	4,0000E+06	1,1500E+00	4,1000E+06	1,1430E+00	4.2000E+06	1,1380E+00	4,3000E+06	1,1300E+00
731	4,4000E+06	1,1250E+00	4,5000E+06	1,1200E+00	4,6000E+06	1,1130E+00	4,7000E+06	1,1080E+00	4,8000E+06	1,1020E+00
736	4,9000E+06	1,0970E+00	5,0000E+06	1,0940E+00	5,1000E+06	1,0900E+00	5,1500E+06	1,0875E+00	5,2000E+06	1,0844E+00
741	5,2500E+06	1,0812E+00	5,3000E+06	1,0777E+00	5,3286E+06	1,0755E+00	5.3500E+06	1,0738E+00	5,4000E+06	1,0696E+00
746	5,4500E+06	1,0650E+00	5,5000E+06	1,0590E+00	5,5500E+06	1,0528E+00	5,6000E+06	1,0500E+00	5,6500E+06	1,0533E+00
751	5,7000E+06	1,0625E+00	5,7500E+06	1,0746E+00	5,8000E+06	1,0875E+00	5,9000E+06	1,1270E+00	6,0000E+06	1,1600E+00
756	6,1000E+06	1,1930E+00	6,2000E+06	1,2320E+00	6,3000E+06	1,2740E+00	6,4000E+06	1,3150E+00	6,5000E+06	1,3580E+00
761	6,6000E+06	1,4000E+00	6,7000E+06	1,4450E+00	6,8000E+06	1,4780E+00	6,9000E+06	1,5150E+00	7,0000E+06	1,5490E+00
766	7,1000E+06	1,5820E+00	7,2000E+06	1,6080E+00	7,3000E+06	1,6370E+00	7,4000E+06	1,6600E+00	7,5000E+06	1,6820E+00
771	7,6000E+06	1,7000E+00	7,6500E+06	1,7100E+00	7,7000E+06	1,7170E+00	7,8000E+06	1,7330E+00	7,9000E+06	1,7470E+00
776	8,0000E+06	1,7580E+00	8,2000E+06	1,7770E+00	8,4000E+06	1,7900E+00	8,5000E+06	1,7960E+00	8,6000E+06	1,8000E+00
781	8,8000E+06	1,8050E+00	9,0000E+06	1,8040E+00	9,2000E+06	1,8000E+00	9,4000E+06	1,7930E+00	9,5000E+06	1,7900E+00
786	9,6000E+06	1,7850E+00	9,8000E+06	1,7770E+00	1,0000E+07	1,7680E+00	1,0500E+07	1,7400E+00	1,1000E+07	1,7180E+00
791	1,1500E+07	1,7170E+00	1,1900E+07	1,7520E+00	1,2000E+07	1,7670E+00	1,2199E+07	1,8010E+00	1,2500E+07	1,8600E+00
796	1,3000E+07	1,9760E+00	1,3500E+07	2,0800E+00	1,4000E+07	2,1520E+00	1,4500E+07	2,2100E+00	1,5000E+07	2,2300E+00
801	1,5500E+07	2,2400E+00	1,6000E+07	2,2300E+00	1,6500E+07	2,2120E+00	1,7000E+07	2,1850E+00	1,7500E+07	2,1500E+00
806	1,8000E+07	2,1180E+00	1,8500E+07	2,0800E+00	1,9000E+07	2,0600E+00	1,9500E+07	2,0520E+00	2,0000E+07	2,0500E+00



10.0x10^3
5.0x10^3
1.0x10^3
5.0x10^2
1.0x10^2
50.
10.
5.0
1.0
σ(b)
.001
.010
.10
1.0
10.0
100.
10.0x10^2
10.0x10^3
10.0x10^4
10.0x10^5
10.0x10^6
En(eV)
235 92 U σnf
74 ANL Po
74 ANL Po
74 ANL Po
73 KFK Ka
73 SAC Bl
71 LAS Le
71 GEL De
71 CAD Sz
71 CAD Sz
70 LAS Cr
70 HAR Pa
68 ANL Po
67 KUR Mo
66 LAS Br
65 ALD Wh
65 DUB Wa
65 DUB Wa
65 SAC Mi
63 LRL Bo
63 CCP Pa
62 CCP Sm
61 MOL De
59 CCP Go
58 ANL Bo
58 COL Me
57 LAS Sm
57 LAS He
57 HAN Se
57 HAR Al
56 SAC Ba
55 SAC Au
55 SAC Au
55 SAC Sz
55 CCP Ad
54 KAP Ye
54 HAN Le
44 LAS Wi
See next page
10.0
5.0
1.0



235 92 U σnf
σ (b)
10.0
5.0
1.0
10.0x10^3
10.0x10^4
10.0x10^5
10.0x10^6
En (eV)

REFERENCES FOR EXPERIMENTAL DATA

$^{235}U(n,f)$

Yr.	Lab	Author	References
74	ANL	Poenitz	Nuc. Sci.&Eng. 53, 370 (1974)
73	KFK	Kaeppeler	KFK 1772 (1973)
73	SAC	Blons	Nuc. Sci.&Eng. 51, 130 (1973)
71	LAS	Lemley, et al.	Nuc. Sci.&Eng. 43, 281 (1971)
71	GEL	Deruytter, et al.	J. Nuc. En. 25, 263 (1971)
71	CAD	Szabo, et al.	Third Conf. Neutron Cross Sections and Tech., Knoxville Tenn. Vol. II, 573 (1971)
70	LAS	Cramer	LA 4420, 45 (1970)
70	HAR	Patrick	J. Nuc. En. 24, 269 (1970)
68	ANL	Poenitz	Second Conf. Neutron Cross Sections & Tech., Washington D.C. Vol I, 503 (1968)
67	KUR	Mostovaya	I.A.E. 1302 (1967)
66	LAS	Brown, et al.	Conf. Neutron Cross Sections & Tech., Washington D.C., Vol II, 971 (1966)
65	ALD	White	J. Nuc. En. 19, 325 (1965)
65	DUB	Wang, et al.	Phys. & Chem. of Fission, Salzburg, Aust., Vol I, 287 (1965)
65	SAC	Michaudon, et al.	Nuc. Phys. 69, 545 (1965)
63	LRL	Bowman	Phys. Rev. 130, 1482 (1963)
63	CCP	Pankratov	At. En. 14, 177 (1963)
62	CCP	Smirenken, et al.	At. En. 13, 366 (1962)
61	MOL	Deruytter, et al.	J. Nuc. En. A/B 15, 165 (1961)
59	CCP	Gorlov, et al.	At. En. 6, 453 (1959)
58	ANL	Bollinger, et al	Priv. Comm. (1958)
58	COL	Melkonian, et al.	Nuc. Sci.&Eng. 3, 435 (1958)

$^{235}U(n,f)$ cont'd

Yr.	Lab	Author	References
57	LAS	Smith, et al.	Bull. Am. Phys. Soc. 2, 196 (1957)
57	LAS	Henkel	LA-2122 (1957)
57	HAN	Seppi, et al.	HW-53492, 22 (1957)
57	HAR	Allen, et al.	Proc. Phys. Soc./A 70, 573 (1957)
56	SAC	Ballini, et al.	Priv. Comm. from Netter (1956)
55	SAC	Auclair, et al.	Int. Peaceful Uses of At. En. Conf. Geneva Vol IV, 235 (1955)
55	SAC	Szteinsznaider, et al.	Int. Peaceful Uses of At. En. Conf. Geneva Vol IV, 245 (1955)
55	CCP	Adamchuk, et al.	Int. Peaceful Uses of At. En. Conf. Geneva Vol IV, 216 (1955)
54	KAP	Yeater, et al.	KAPL -1109 (1954)
54	HAN	Leonard	HW-33384, 33 (1954)
44	LAS	Williams	LA-150 (1944)

92- U-238 WARD EVAL-SEPT73N.C.PAIK
DIST-MAY74 REV-NOV74
P.C. TO NORMALIZATION AND STANDARDS SUBCOMMITTEE MARCH 1974
PERTINENT HOLLORITH FROM GENERAL FILE FOLLOWS (MAT 1262)
ALL REFERENCES CARRIED OVER FROM GENERAL FILE

MF = 2
RESONANCE PARAMETERS

RESOLVED RESONANCE PARAMETERS
F.J. MCCROSSON (SAVANNAH RIVER LABORATORY) . IN THE EVALUATION RESULTS OF TESTINGS OF PRELIMINARY PARAMETERS ON ISOLATED ROD RESONANCE INTEGRAL CALCULATIONS BY J. HARDY (BETTIS ATOMIC POWER LABORATORY) WERE CONSIDERED. COMMENTS BY G. DESAUSSURE (ORNL) AND BY PAIK CONSIDERED IN THE FINAL VALUES.

MT=151 RESOLVED RESONANCES - PARAMETERS INCLUDED FOR 190 S-WAVE AND 220 P-WAVE RESONANCES BASED PRIMARILY ON DATA OF REF 1-7. MEASURED PARAMETERS WERE MODIFIED TO IMPROVE FIT TO POINTWISE CAPTURE MEASUREMENTS OF REF 8. RESOLVED RANGE: 1 EV-4 KEV.
UNRESOLVED RESONANCES - AVERAGE RADIATION WIDTH=0.0235EV, ENERGY RANGE 4 KEV TO 45 KEV.STATISTICAL FIT TO DATA BY PAIK (REF. 36) SAME TECHNIQUE AS WAS DONE FOR ENDF/B III. AVERAGE S-WAVE LEVEL SPACING=20.0 EV,S-WAVE STRENGTH FUNCTION =1.05E-4BASED ON EVALUATED RESOLVED RESONANCES. P-WAVE STRENGTH FUNCTION OBTAINED BY ADJUSTING CALCULATION TO THE EVALUATED CAPTURE CROSS SECTION. NEUTRON WIDTHS AND LEVEL SPACING ARE GIVEN AS ENERGY DEPENDENT AT 15 ENERGIES BETWEEN 4.00 AND 45.0 KEV. P-WAVE PENETRATION FACTORS TO BE CALCULATED USING A RADIUS OF 8.4 FERMI PER REVISED ENDF/B FORMATS.
THE TECHNIQUE IS ESSENTIALLY SAME AS WAS FOR ENDF/B 3.

MF = 3

MT=18 FISSION RATIO RELATIVE TO U-235 EVALUATED FROM 0.98 TIMES LAMPHERE(REF.25) BELOW 2 MEV. REFS. 26 AND 27 BETWEEN 2.0 -- 5.4 MEV. AND REFS. 27 AND 28 WITH CORRECTIONS TO REF. 28. THESE RATIOS ARE IN GOOD AGREEMENT WITH MEASURED VALUES OF REFERENCES 31 AND 32.
THESE FISSION RATIOS WERE COMBINED WITH THE ENDF/B IV U-235 FISSION CROSS SECTIONS.

MT=102 (N,GAMMA) - METHODS OF REF. 9 USED BELOW 1 EV. BUT VALUE OF 2.70 B USED AT .0253 EV. RATHER THAN 2.72 B. SMOOTH CROSS SEC (1 EV-45 KEV) INCLUDE CONTRIBUTIONS FROM (A) BOUND LEVELS (1-100 EV). (B) UNRESOLVED P-WAVE RESONANCES (.68-4 KEV). AND (C) A SMALL D-WAVE COMPONENT (10-45 KEV).
BETWEEN 4 AND 100 KEV. BASED ON AVERAGE OF REFS. 38 AND 8.
ABOVE 100 KEV.THE EVALUATION ARE DETERMINED BY FRIESENHAHN (REF.33). RYVES(REF. 34)AND REFERENCE 35.
ABOVE 2 MEV THE EVALUATION BY DEVANEY (REF.37) WAS ADOPTED

REFERENCES

1. ASGHAR,M.,ET AL.,NUC.PHYS.,85,305(1966)
2. BOLLINGER,L.M.,THOMAS,G.E.,PHYS.REV.,171,1293(1968)
3. CARRARO,G.,KOLAR,W.,NUC.DATA FOR REACTORS,VOL.1,IAEA(1970)
4. CARRARO,G.,KOLAR,W.,CONF-710301,701(1971)
5. MALETSKI,KH.,ET AL.,SOV.AT.ENG.,32,45(1972)
6. RAHN,F.,ET AL.,PHYS.REV.,6C,1854(1972)
7. ROHR,G.,ET AL.,NUC.DATA FOR REACTORS,VOL.1,IAEA(1970)
8. DE SAUSSURE,G.,ET AL.,ORNL-TM-4059(1973)
9. LEONARD,JR.,B.R.,BNWL-1586(ENDF-153) (1971)
10. SOLEILHAC,M.,ET,AL., J.NUC.EN. 23,257(1969)
11. UTTLEY,C.A., PRIVATE COMMUNICATION(1967)
12. KOPSCH,D.,ET.AL.,NUC.DATA FOR REACTORS,VOL.2,IAEA(1970)
13. WHALEN,J.,ET.AL., PRIVATE COMM. A.B. SMITH(1969)
14. FOSTER,D.G., UNPUBLISHED (1967)
15. HEATON,W. ET AL., USNBS TO CSEWG. PRIVATE COMMUNICATION(1973)
16. SMITH,A.B., COMMENTS ON THE INELASTIC SCATTERING OF U-238. PRIVATE COMMUNICATION TO CSEWG, SEPT.24 (1974)
17. BATCHELOR,R.ET AL., NUC. PHY. 65, 236 (1965)
18. BETHE,H.A.,ET.AL., LA-1939 (1955)
19. MACGREGOR,M.H.,ET.AL., PHY.REV. 130,1471(1963)
20. DEGTYAREV,Y.G., ATOMNAYA ENERGIYA 19, 456(1965)
21. BARNARD,E.,ET. AL., NUC. PHY. 80, 46 (1966)
22. KNIGHT,J.D.,PHY.REV.112,259(1958) CORRECTED BY D.BARR(1966).
23. GRAVES,ET AL,QUOTED BY REF.18 AND CORRECTED BY V.BARR(1966)
24. MATHER,D.S,PAIN,L.F., AWRE 047/69 (1969)
25. LAMPHERE,R.W., PHY. REV. 104. 1654 (1956)
26. STEIN,W.E.,ET.AL.,CONF.WASHINGTON,D.C.,NBS PUB.299 (1968)
27. WHITE,P.H.,WARNER,G.P., J. NUC. ENERGY, VOL. 21, P 671 (1967)
28. SMITH,R.K.,HENKEL,R.L.,NOBLES,R.A., BULL. AM.PHYS.SOC.2(1957)
29. PITTERLE,T.A., N.C. PAIK,C.DURSTON, WARD-4210-1(1970)
30. BNL-400, THIRD EDITION, VOL. 2(1970)
31. MEADOWS,J.W., NUCL. SCI. ENG. 49, 310 (1972)
32. POENITZ AND R.J.ARMANI,J.NUCL.ENERGY 26,483(1972)
33. FRIESENHAHN,S.J. ET AL., GA-10194, JUNE (1970)
34. RYVES,T.B. ET AL., NATIONAL PHYSICAL LABORATORY, ENGLAND, PRIVATE COMMUNICATION WITH W-ARD (1972)
35. MENLOVE AND W.P.POENITZ,NUCL. SCI. ENG. 33,24 (1968)
36. PAIK,N.C.,ET AL., WARD-XS-3045-2, JULY, 1973
37. DEVANEY,J.J., NUCL.SCI. ENG. 51,272-277(1973)
38. MOXON,M.C., AERE-R6074 (1969) AND PRIVATE COMM.(1971)

URANIUM-238

ENDF/B MATERIAL NO. 6262

TABLE OF CONTENTS

GENERAL INFORMATION

URANIUM-238

ENDF/B MATERIAL NO. 6262

RESONANCE DATA

RESONANCE PARAMETERS

ISOTOPE-----------------------URANIUM-238
FRACTIONAL ABUNDANCE---------- 1.0000E+00
NUMBER OF ENERGY RANGES------ 2

ENERGY RANGE NUMBER---------- 1

RESOLVED SINGLE-LEVEL BREIT-WIGNER PARAMETERS

LOWER ENERGY LIMIT (EV)------ 1.0000E+00
UPPER ENERGY LIMIT (EV)------ 4.0000E+03
NUCLEAR SPIN----------------- 0.0000E+00
SPIN SCATTERING LENGTH (A+)-- 9.1840E-01
NUMBER OF L STATES----------- 2

L VALUE---------------------- 0
NUMBER OF RESONANCES--------- 190
SPIN SCATTERING LENGTH (A-)-- 0.0000E+00

INDEX	ENERGY (EV)	J VALUE	RESONANCE WIDTHS (EV) TOTAL	NEUTRON	RADIATION	FISSION
1	6.6700E+00	5.0000E-01	2.7100E-02	1.5000E-03	2.5600E-02	0.0000E+00
2	2.0900E+01	5.0000E-01	3.5600E-02	8.8000E-03	2.6800E-02	0.0000E+00
3	3.6800E+01	5.0000E-01	5.7100E-02	3.1100E-02	2.6000E-02	0.0000E+00
4	6.6150E+01	5.0000E-01	4.8800E-02	2.5300E-02	2.3500E-02	0.0000E+00
5	8.0740E+01	5.0000E-01	2.5500E-02	2.0000E-03	2.3500E-02	0.0000E+00
6	1.0250E+02	5.0000E-01	9.7000E-02	7.1000E-02	2.6000E-02	0.0000E+00
7	1.1680E+02	5.0000E-01	5.1770E-02	2.8270E-02	2.3500E-02	0.0000E+00
8	1.4560E+02	5.0000E-01	2.4390E-02	8.9000E-04	2.3500E-02	0.0000E+00
9	1.6520E+02	5.0000E-01	2.6900E-02	3.4000E-03	2.3500E-02	0.0000E+00
10	1.8960E+02	5.0000E-01	1.9370E-01	1.6900E-01	2.4700E-02	0.0000E+00
11	2.0840E+02	5.0000E-01	7.8590E-02	5.5090E-02	2.3500E-02	0.0000E+00
12	2.3720E+02	5.0000E-01	5.2610E-02	2.9110E-02	2.3500E-02	0.0000E+00
13	2.7360E+02	5.0000E-01	5.0100E-02	2.7000E-02	2.3100E-02	0.0000E+00
14	2.9100E+02	5.0000E-01	4.0080E-02	1.6980E-02	2.3100E-02	0.0000E+00
15	3.1120E+02	5.0000E-01	2.4600E-02	1.1000E-03	2.3500E-02	0.0000E+00
16	3.4770E+02	5.0000E-01	1.0710E-01	8.3600E-02	2.3500E-02	0.0000E+00
17	3.7680E+02	5.0000E-01	2.4760E-02	1.2600E-03	2.3500E-02	0.0000E+00
18	3.9740E+02	5.0000E-01	3.1600E-02	6.4000E-03	2.5200E-02	0.0000E+00
19	4.1020E+02	5.0000E-01	4.3200E-02	2.0600E-02	2.2600E-02	0.0000E+00
20	4.3370E+02	5.0000E-01	3.3480E-02	9.9800E-03	2.3500E-02	0.0000E+00
21	4.5410E+02	5.0000E-01	2.3960E-02	4.6000E-04	2.3500E-02	0.0000E+00
22	4.6280E+02	5.0000E-01	2.9000E-02	5.5000E-03	2.3500E-02	0.0000E+00
23	4.7830E+02	5.0000E-01	2.7300E-02	3.8000E-03	2.3500E-02	0.0000E+00
24	5.1830E+02	5.0000E-01	7.6000E-02	5.1600E-02	2.4400E-02	0.0000E+00
25	5.3520E+02	5.0000E-01	7.0500E-02	4.7000E-02	2.3500E-02	0.0000E+00
26	5.5590E+02	5.0000E-01	2.4300E-02	8.0000E-04	2.3500E-02	0.0000E+00
27	5.7990E+02	5.0000E-01	6.7600E-02	4.4100E-02	2.3500E-02	0.0000E+00
28	5.9480E+02	5.0000E-01	1.0820E-01	8.5100E-02	2.3100E-02	0.0000E+00
29	6.1980E+02	5.0000E-01	5.6500E-02	3.3000E-02	2.3500E-02	0.0000E+00
30	6.2850E+02	5.0000E-01	3.0200E-02	6.7000E-03	2.3500E-02	0.0000E+00
31	6.6110E+02	5.0000E-01	1.6070E-01	1.3560E-01	2.5100E-02	0.0000E+00
32	6.9290E+02	5.0000E-01	6.7900E-02	4.3800E-02	2.4100E-02	0.0000E+00
33	7.0800E+02	5.0000E-01	4.7000E-02	2.1000E-02	2.6000E-02	0.0000E+00
34	7.2140E+02	5.0000E-01	2.5900E-02	1.2000E-03	2.3500E-02	1.2000E-03
35	7.3250E+02	5.0000E-01	2.6000E-02	2.5000E-03	2.3500E-02	0.0000E+00
36	7.6500E+02	5.0000E-01	3.1120E-02	7.6200E-03	2.3500E-02	0.0000E+00
37	7.7930E+02	5.0000E-01	2.5500E-02	2.0000E-03	2.3500E-02	0.0000E+00
38	7.9070E+02	5.0000E-01	3.0030E-02	6.5300E-03	2.3500E-02	0.0000E+00
39	8.2150E+02	5.0000E-01	9.0000E-02	6.6000E-02	2.4000E-02	0.0000E+00
40	8.5060E+02	5.0000E-01	7.8100E-02	5.5100E-02	2.3000E-02	0.0000E+00
41	8.5610E+02	5.0000E-01	1.0630E-01	8.2700E-02	2.3600E-02	0.0000E+00
42	8.6600E+02	5.0000E-01	2.9200E-02	5.7000E-03	2.3500E-02	0.0000E+00
43	9.0450E+02	5.0000E-01	7.8800E-02	5.2000E-02	2.6800E-02	0.0000E+00
44	9.2450E+02	5.0000E-01	3.7400E-02	1.3900E-02	2.3500E-02	0.0000E+00
45	9.3660E+02	5.0000E-01	1.6020E-01	1.3660E-01	2.3600E-02	0.0000E+00
46	9.5800E+02	5.0000E-01	2.1310E-01	1.9040E-01	2.2700E-02	0.0000E+00
47	9.9140E+02	5.0000E-01	4.2000E-01	3.9000E-01	3.0000E-02	0.0000E+00
48	1.0110E+03	5.0000E-01	2.5090E-02	1.5900E-03	2.3500E-02	0.0000E+00
49	1.0229E+03	5.0000E-01	3.1800E-02	8.3000E-03	2.3500E-02	0.0000E+00
50	1.0294E+03	5.0000E-01	2.6000E-02	2.5000E-03	2.3500E-02	0.0000E+00
51	1.0540E+03	5.0000E-01	1.1250E-01	8.9000E-02	2.3500E-02	0.0000E+00
52	1.0990E+03	5.0000E-01	3.9000E-02	1.7000E-02	2.2000E-02	0.0000E+00
53	1.1089E+03	5.0000E-01	5.0500E-02	2.7000E-02	2.3500E-02	0.0000E+00

54	1,1311E+03	5,0000E-01	2,6500E-02	3,0000E-03	2,3500E-02	0,0000E+00
55	1,1409E+03	5,0000E-01	2,4350E-01	2,2000E-01	2,3500E-02	0,0000E+00
56	1,1672E+03	5,0000E-01	3,2000E-02	8,5000E-03	2,3500E-02	0,0000E+00
57	1,1766E+03	5,0000E-01	8,3500E-02	6,0000E-02	2,3500E-02	0,0000E+00
58	1,1942E+03	5,0000E-01	1,1250E-01	8,9000E-02	2,3500E-02	0,0000E+00
59	1,2111E+03	5,0000E-01	3,2620E-02	9,0000E-03	2,3500E-02	1,2000E-04
60	1,2449E+03	5,0000E-01	3,0350E-01	2,8000E-01	2,3500E-02	0,0000E+00
61	1,2660E+03	5,0000E-01	4,3100E-02	2,2100E-02	2,1000E-02	0,0000E+00
62	1,2727E+03	5,0000E-01	5,0500E-02	2,7000E-02	2,3500E-02	0,0000E+00
63	1,2981E+03	5,0000E-01	2,8000E-02	4,5000E-03	2,3500E-02	0,0000E+00
64	1,3163E+03	5,0000E-01	2,7500E-02	4,0000E-03	2,3500E-02	0,0000E+00
65	1,3327E+03	5,0000E-01	2,5100E-02	1,6000E-03	2,3500E-02	0,0000E+00
66	1,3932E+03	5,0000E-01	2,0550E-01	1,8200E-01	2,3500E-02	0,0000E+00
67	1,4052E+03	5,0000E-01	9,3500E-02	7,0000E-02	2,3500E-02	0,0000E+00
68	1,4192E+03	5,0000E-01	3,2500E-02	9,0000E-03	2,3500E-02	0,0000E+00
69	1,4279E+03	5,0000E-01	5,5100E-02	2,9100E-02	2,6000E-02	0,0000E+00
70	1,4432E+03	5,0000E-01	4,1500E-02	1,8000E-02	2,3500E-02	0,0000E+00
71	1,4734E+03	5,0000E-01	1,4850E-01	1,2500E-01	2,3500E-02	0,0000E+00
72	1,5223E+03	5,0000E-01	2,6350E-01	2,4000E-01	2,3500E-02	0,0000E+00
73	1,5330E+03	5,0000E-01	2,3900E-02	4,0000E-04	2,3500E-02	0,0000E+00
74	1,5462E+03	5,0000E-01	2,7500E-02	4,0000E-03	2,3500E-02	0,0000E+00
75	1,5660E+03	5,0000E-01	2,8900E-02	5,4000E-03	2,3500E-02	0,0000E+00
76	1,5972E+03	5,0000E-01	3,7850E-01	3,5500E-01	2,3500E-02	0,0000E+00
77	1,6220E+03	5,0000E-01	9,3500E-02	7,0000E-02	2,3500E-02	0,0000E+00
78	1,6374E+03	5,0000E-01	7,3500E-02	5,0000E-02	2,3500E-02	0,0000E+00
79	1,6613E+03	5,0000E-01	1,9350E-01	1,7000E-01	2,3500E-02	0,0000E+00
80	1,6883E+03	5,0000E-01	1,1550E-01	9,2000E-02	2,3500E-02	0,0000E+00
81	1,7090E+03	5,0000E-01	1,1200E-01	8,4000E-02	2,8000E-02	0,0000E+00
82	1,7222E+03	5,0000E-01	3,8500E-02	1,5000E-02	2,3500E-02	0,0000E+00
83	1,7552E+03	5,0000E-01	1,3200E-01	1,0500E-01	2,7000E-02	0,0000E+00
84	1,7821E+03	5,0000E-01	6,9350E-01	6,7000E-01	2,3500E-02	0,0000E+00
85	1,7952E+03	5,0000E-01	2,6500E-02	3,0000E-03	2,3500E-02	0,0000E+00
86	1,8079E+03	5,0000E-01	3,8000E-02	1,4500E-02	2,3500E-02	0,0000E+00
87	1,8452E+03	5,0000E-01	3,6500E-02	1,3000E-02	2,3500E-02	0,0000E+00
88	1,8680E+03	5,0000E-01	2,6200E-02	2,7000E-03	2,3500E-02	0,0000E+00
89	1,8700E+03	5,0000E-01	2,6200E-02	2,7000E-03	2,3500E-02	0,0000E+00
90	1,9024E+03	5,0000E-01	5,3500E-02	3,0000E-02	2,3500E-02	0,0000E+00
91	1,9162E+03	5,0000E-01	4,8400E-02	2,4900E-02	2,3500E-02	0,0000E+00
92	1,9534E+03	5,0000E-01	2,7200E-02	3,7000E-03	2,3500E-02	0,0000E+00
93	1,9686E+03	5,0000E-01	6,9500E-01	6,7000E-01	2,5000E-02	0,0000E+00
94	1,9743E+03	5,0000E-01	5,2350E-01	5,0000E-01	2,3500E-02	0,0000E+00
95	2,0228E+03	5,0000E-01	2,3850E-01	2,1500E-01	2,3500E-02	0,0000E+00
96	2,0298E+03	5,0000E-01	8,4500E-02	6,1000E-02	2,3500E-02	0,0000E+00
97	2,0709E+03	5,0000E-01	2,6500E-02	3,0000E-03	2,3500E-02	0,0000E+00
98	2,0881E+03	5,0000E-01	5,0500E-02	2,7000E-02	2,3500E-02	0,0000E+00
99	2,0959E+03	5,0000E-01	4,6500E-02	2,3000E-02	2,3500E-02	0,0000E+00
100	2,1238E+03	5,0000E-01	2,6700E-02	3,2000E-03	2,3500E-02	0,0000E+00
101	2,1446E+03	5,0000E-01	8,5500E-02	6,2000E-02	2,3500E-02	0,0000E+00
102	2,1522E+03	5,0000E-01	2,6350E-01	2,4000E-01	2,3500E-02	0,0000E+00
103	2,1860E+03	5,0000E-01	6,4350E-01	6,2000E-01	2,3500E-02	0,0000E+00
104	2,2006E+03	5,0000E-01	1,4350E-01	1,2000E-01	2,3500E-02	0,0000E+00
105	2,2170E+03	5,0000E-01	2,7500E-02	4,0000E-03	2,3500E-02	0,0000E+00
106	2,2410E+03	5,0000E-01	2,5000E-02	1,5000E-03	2,3500E-02	0,0000E+00
107	2,2580E+03	5,0000E-01	1,0950E-01	8,6000E-02	2,3500E-02	0,0000E+00
108	2,2670E+03	5,0000E-01	2,3350E-01	2,1000E-01	2,3500E-02	0,0000E+00
109	2,2817E+03	5,0000E-01	1,5850E-01	1,3500E-01	2,3500E-02	0,0000E+00
110	2,3152E+03	5,0000E-01	4,4500E-02	2,1000E-02	2,3500E-02	0,0000E+00
111	2,3390E+03	5,0000E-01	3,3000E-02	9,5000E-03	2,3500E-02	0,0000E+00
112	2,3528E+03	5,0000E-01	7,0500E-02	4,7000E-02	2,3500E-02	0,0000E+00
113	2,3553E+03	5,0000E-01	8,4500E-02	6,1000E-02	2,3500E-02	0,0000E+00
114	2,3914E+03	5,0000E-01	4,9500E-02	2,6000E-02	2,3500E-02	0,0000E+00
115	2,4108E+03	5,0000E-01	2,8100E-02	4,6000E-03	2,3500E-02	0,0000E+00
116	2,4257E+03	5,0000E-01	1,5850E-01	1,3500E-01	2,3500E-02	0,0000E+00
117	2,4452E+03	5,0000E-01	2,1850E-01	1,9500E-01	2,3500E-02	0,0000E+00
118	2,4540E+03	5,0000E-01	4,2500E-02	1,9000E-02	2,3500E-02	0,0000E+00
119	2,4884E+03	5,0000E-01	1,1150E-01	8,8000E-02	2,3500E-02	0,0000E+00
120	2,5207E+03	5,0000E-01	3,7500E-02	1,4000E-02	2,3500E-02	0,0000E+00
121	2,5472E+03	5,0000E-01	5,7350E-01	5,5000E-01	2,3500E-02	0,0000E+00
122	2,5582E+03	5,0000E-01	2,5350E-01	2,3000E-01	2,3500E-02	0,0000E+00
123	2,5799E+03	5,0000E-01	3,5350E-01	3,3000E-01	2,3500E-02	0,0000E+00
124	2,5962E+03	5,0000E-01	6,9350E-01	6,7000E-01	2,3500E-02	0,0000E+00
125	2,6191E+03	5,0000E-01	6,8500E-02	4,5000E-02	2,3500E-02	0,0000E+00
126	2,6317E+03	5,0000E-01	2,7000E-02	3,5000E-03	2,3500E-02	0,0000E+00
127	2,6713E+03	5,0000E-01	2,6350E-01	2,4000E-01	2,3500E-02	0,0000E+00
128	2,6956E+03	5,0000E-01	4,2500E-02	1,9000E-02	2,3500E-02	0,0000E+00
129	2,7162E+03	5,0000E-01	1,6850E-01	1,4500E-01	2,3500E-02	0,0000E+00
130	2,7324E+03	5,0000E-01	2,5300E-02	1,8000E-03	2,3500E-02	0,0000E+00
131	2,7497E+03	5,0000E-01	6,8500E-02	4,5000E-02	2,3500E-02	0,0000E+00
132	2,7616E+03	5,0000E-01	4,6600E-02	2,3100E-02	2,3500E-02	0,0000E+00
133	2,7860E+03	5,0000E-01	3,5600E-02	1,2100E-02	2,3500E-02	0,0000E+00
134	2,8054E+03	5,0000E-01	3,1500E-02	8,0000E-03	2,3500E-02	0,0000E+00
135	2,8280E+03	5,0000E-01	4,1000E-02	1,7500E-02	2,3500E-02	0,0000E+00
136	2,8641E+03	5,0000E-01	1,9850E-01	1,7500E-01	2,3500E-02	0,0000E+00
137	2,8820E+03	5,0000E-01	5,7350E-01	5,5000E-01	2,3500E-02	0,0000E+00
138	2,8963E+03	5,0000E-01	3,8500E-02	1,5000E-02	2,3500E-02	0,0000E+00
139	2,9330E+03	5,0000E-01	5,4500E-02	3,1000E-02	2,3500E-02	0,0000E+00
140	2,9557E+03	5,0000E-01	4,4500E-02	2,1000E-02	2,3500E-02	0,0000E+00
141	2,9658E+03	5,0000E-01	2,6800E-02	3,3000E-03	2,3500E-02	0,0000E+00
142	2,9863E+03	5,0000E-01	2,9000E-02	5,5000E-03	2,3500E-02	0,0000E+00
143	3,0024E+03	5,0000E-01	1,4050E-01	1,1700E-01	2,3500E-02	0,0000E+00
144	3,0151E+03	5,0000E-01	2,5150E-02	1,6500E-03	2,3500E-02	0,0000E+00
145	3,0278E+03	5,0000E-01	1,4850E-01	1,2500E-01	2,3500E-02	0,0000E+00
146	3,0422E+03	5,0000E-01	2,7000E-02	3,5000E-03	2,3500E-02	0,0000E+00

147	3.0581E+03	5.0000E-01	5.5500E-02	3.2000E-02	2.3500E-02	0.0000E+00
148	3.1088E+03	5.0000E-01	2.1350E-01	1.9000E-01	2.3500E-02	0.0000E+00
149	3.1325E+03	5.0000E-01	3.1500E-02	8.0000E-03	2.3500E-02	0.0000E+00
150	3.1481E+03	5.0000E-01	9.8500E-02	7.5000E-02	2.3500E-02	0.0000E+00
151	3.1685E+03	5.0000E-01	3.5500E-02	1.2000E-02	2.3500E-02	0.0000E+00
152	3.1778E+03	5.0000E-01	9.7500E-02	7.4000E-02	2.3500E-02	0.0000E+00
153	3.1881E+03	5.0000E-01	1.0350E-01	8.0000E-02	2.3500E-02	0.0000E+00
154	3.2049E+03	5.0000E-01	9.6500E-02	7.3000E-02	2.3500E-02	0.0000E+00
155	3.2170E+03	5.0000E-01	3.1500E-02	8.0000E-03	2.3500E-02	0.0000E+00
156	3.2249E+03	5.0000E-01	5.6500E-02	3.3000E-02	2.3500E-02	0.0000E+00
157	3.2481E+03	5.0000E-01	5.1500E-02	2.8000E-02	2.3500E-02	0.0000E+00
158	3.2720E+03	5.0000E-01	3.1500E-02	8.0000E-03	2.3500E-02	0.0000E+00
159	3.2782E+03	5.0000E-01	2.5850E-01	2.3500E-01	2.3500E-02	0.0000E+00
160	3.2952E+03	5.0000E-01	3.1500E-02	8.0000E-03	2.3500E-02	0.0000E+00
161	3.3103E+03	5.0000E-01	1.4650E-01	1.2300E-01	2.3500E-02	0.0000E+00
162	3.3202E+03	5.0000E-01	1.2650E-01	1.0300E-01	2.3500E-02	0.0000E+00
163	3.3329E+03	5.0000E-01	9.3500E-02	7.0000E-02	2.3500E-02	0.0000E+00
164	3.3540E+03	5.0000E-01	1.3150E-01	1.0800E-01	2.3500E-02	0.0000E+00
165	3.3883E+03	5.0000E-01	3.8000E-02	1.4500E-02	2.3500E-02	0.0000E+00
166	3.4079E+03	5.0000E-01	2.1350E-01	1.9000E-01	2.3500E-02	0.0000E+00
167	3.4177E+03	5.0000E-01	2.7600E-02	4.1000E-03	2.3500E-02	0.0000E+00
168	3.4353E+03	5.0000E-01	3.7350E-01	3.5000E-01	2.3500E-02	0.0000E+00
169	3.4563E+03	5.0000E-01	5.2350E-01	5.0000E-01	2.3500E-02	0.0000E+00
170	3.4843E+03	5.0000E-01	1.2850E-01	1.0500E-01	2.3500E-02	0.0000E+00
171	3.4933E+03	5.0000E-01	3.2900E-02	9.4000E-03	2.3500E-02	0.0000E+00
172	3.5264E+03	5.0000E-01	2.8500E-02	5.0000E-03	2.3500E-02	0.0000E+00
173	3.5605E+03	5.0000E-01	2.4350E-01	2.2000E-01	2.3500E-02	0.0000E+00
174	3.5727E+03	5.0000E-01	3.5350E-01	3.3000E-01	2.3500E-02	0.0000E+00
175	3.5933E+03	5.0000E-01	6.3500E-02	4.0000E-02	2.3500E-02	0.0000E+00
176	3.6218E+03	5.0000E-01	4.3500E-02	2.0000E-02	2.3500E-02	0.0000E+00
177	3.6283E+03	5.0000E-01	4.4350E-01	4.2000E-01	2.3500E-02	0.0000E+00
178	3.6718E+03	5.0000E-01	3.1400E-02	7.9000E-03	2.3500E-02	0.0000E+00
179	3.6920E+03	5.0000E-01	3.4350E-01	3.2000E-01	2.3500E-02	0.0000E+00
180	3.7155E+03	5.0000E-01	1.0350E-01	8.0000E-02	2.3500E-02	0.0000E+00
181	3.7372E+03	5.0000E-01	2.1850E-01	1.9500E-01	2.3500E-02	0.0000E+00
182	3.7630E+03	5.0000E-01	9.5500E-02	7.2000E-02	2.3500E-02	0.0000E+00
183	3.7808E+03	5.0000E-01	3.7350E-01	3.5000E-01	2.3500E-02	0.0000E+00
184	3.8303E+03	5.0000E-01	3.4500E-02	1.1000E-02	2.3500E-02	0.0000E+00
185	3.8564E+03	5.0000E-01	5.1850E-01	4.9500E-01	2.3500E-02	0.0000E+00
186	3.8721E+03	5.0000E-01	1.9350E-01	1.7000E-01	2.3500E-02	0.0000E+00
187	3.9013E+03	5.0000E-01	2.9350E-01	2.7000E-01	2.3500E-02	0.0000E+00
188	3.9139E+03	5.0000E-01	1.1350E-01	9.0000E-02	2.3500E-02	0.0000E+00
189	3.9390E+03	5.0000E-01	1.5350E-01	1.3000E-01	2.3500E-02	0.0000E+00
190	3.9539E+03	5.0000E-01	1.3250E-01	1.0900E-01	2.3500E-02	0.0000E+00

L VALUE---------------------- 1
NUMBER OF RESONANCES---------- 220
SPIN SCATTERING LENGTH (A-)-- 0.0000E+00

INDEX	ENERGY (EV)	J VALUE	RESONANCE WIDTHS (EV) TOTAL	NEUTRON	RADIATION	FISSION
1	1.0220E+01	5.0000E-01	2.3502E-02	1.5600E-06	2.3500E-02	0.0000E+00
2	1.9500E+01	5.0000E-01	2.3501E-02	1.0000E-06	2.3500E-02	0.0000E+00
3	4.5190E+01	5.0000E-01	2.3501E-02	1.0000E-06	2.3500E-02	0.0000E+00
4	4.9500E+01	5.0000E-01	2.3501E-02	6.0000E-07	2.3500E-02	0.0000E+00
5	6.3540E+01	5.0000E-01	2.3506E-02	5.5000E-06	2.3500E-02	0.0000E+00
6	8.3570E+01	5.0000E-01	2.3506E-02	6.3000E-06	2.3500E-02	0.0000E+00
7	8.9190E+01	5.0000E-01	2.3590E-02	9.0000E-05	2.3500E-02	0.0000E+00
8	9.1000E+01	5.0000E-01	2.3506E-02	6.0000E-06	2.3500E-02	0.0000E+00
9	9.3300E+01	5.0000E-01	2.3505E-02	5.0000E-06	2.3500E-02	0.0000E+00
10	9.8200E+01	5.0000E-01	2.3508E-02	8.0000E-06	2.3500E-02	0.0000E+00
11	1.1140E+02	5.0000E-01	2.3510E-02	1.0000E-05	2.3500E-02	0.0000E+00
12	1.2160E+02	5.0000E-01	2.3506E-02	6.0000E-06	2.3500E-02	0.0000E+00
13	1.2430E+02	5.0000E-01	2.3516E-02	1.6000E-05	2.3500E-02	0.0000E+00
14	1.3330E+02	5.0000E-01	2.3513E-02	1.3000E-05	2.3500E-02	0.0000E+00
15	1.5240E+02	5.0000E-01	2.3537E-02	3.7000E-05	2.3500E-02	0.0000E+00
16	1.5890E+02	5.0000E-01	2.3512E-02	1.2000E-05	2.3500E-02	0.0000E+00
17	1.7310E+02	5.0000E-01	2.3530E-02	3.0000E-05	2.3500E-02	0.0000E+00
18	1.9640E+02	5.0000E-01	2.3530E-02	3.0000E-05	2.3500E-02	0.0000E+00
19	2.0050E+02	5.0000E-01	2.3540E-02	4.0000E-05	2.3500E-02	0.0000E+00
20	2.0300E+02	5.0000E-01	2.3520E-02	2.0000E-05	2.3500E-02	0.0000E+00
21	2.1500E+02	5.0000E-01	2.3541E-02	4.1000E-05	2.3500E-02	0.0000E+00
22	2.1880E+02	5.0000E-01	2.3530E-02	3.0000E-05	2.3500E-02	0.0000E+00
23	2.3990E+02	5.0000E-01	2.3550E-02	5.0000E-05	2.3500E-02	0.0000E+00
24	2.4260E+02	5.0000E-01	2.3656E-02	1.5600E-04	2.3500E-02	0.0000E+00
25	2.5390E+02	5.0000E-01	2.3600E-02	1.0000E-04	2.3500E-02	0.0000E+00
26	2.5760E+02	5.0000E-01	2.3525E-02	2.5000E-05	2.3500E-02	0.0000E+00
27	2.6390E+02	5.0000E-01	2.3730E-02	2.3000E-04	2.3500E-02	0.0000E+00
28	2.7580E+02	5.0000E-01	2.3640E-02	1.4000E-04	2.3500E-02	0.0000E+00
29	2.8230E+02	5.0000E-01	2.3610E-02	1.1000E-04	2.3500E-02	0.0000E+00
30	2.9500E+02	5.0000E-01	2.3550E-02	5.0000E-05	2.3500E-02	0.0000E+00
31	3.0630E+02	5.0000E-01	2.3520E-02	2.0000E-05	2.3500E-02	0.0000E+00
32	3.2280E+02	5.0000E-01	2.3545E-02	4.5000E-05	2.3500E-02	0.0000E+00
33	3.3130E+02	5.0000E-01	2.3550E-02	5.0000E-05	2.3500E-02	0.0000E+00
34	3.3700E+02	5.0000E-01	2.3610E-02	1.1000E-04	2.3500E-02	0.0000E+00
35	3.5180E+02	5.0000E-01	2.3700E-02	2.0000E-04	2.3500E-02	0.0000E+00
36	3.5470E+02	5.0000E-01	2.3530E-02	3.0000E-05	2.3500E-02	0.0000E+00
37	3.6640E+02	5.0000E-01	2.3524E-02	2.4000E-05	2.3500E-02	0.0000E+00
38	3.7370E+02	5.0000E-01	2.3540E-02	4.0000E-05	2.3500E-02	0.0000E+00

39	3,9550E+02	5.0000E-01	2.3560E-02	6.0000E-05	2,3500E-02	0,0000E+00
40	4,0050E+02	5.0000E-01	2.3540E-02	4.0000E-05	2,3500E-02	0,0000E+00
41	4,0760E+02	5.0000E-01	2.3600E-02	1.0000E-04	2,3500E-02	0,0000E+00
42	4,1350E+02	5.0000E-01	2.3550E-02	5.0000E-05	2,3500E-02	0,0000E+00
43	4,1550E+02	5.0000E-01	2.3525E-02	2.5000E-05	2,3500E-02	0,0000E+00
44	4,3970E+02	5.0000E-01	2.3810E-02	3.1000E-04	2,3500E-02	0,0000E+00
45	4,4840E+02	5.0000E-01	2.3560E-02	6.0000E-05	2,3500E-02	0,0000E+00
46	4,6680E+02	5.0000E-01	2.3600E-02	1.0000E-04	2,3500E-02	0,0000E+00
47	4,8400E+02	5.0000E-01	2.3620E-02	1.2000E-04	2,3500E-02	0,0000E+00
48	4,8820E+02	5.0000E-01	2.4120E-02	6.2000E-04	2,3500E-02	0,0000E+00
49	4,9890E+02	5.0000E-01	2.3620E-02	1.2000E-04	2,3500E-02	0,0000E+00
50	5,2320E+02	5.0000E-01	2.3770E-02	2.7000E-04	2,3500E-02	0,0000E+00
51	5,4230E+02	5.0000E-01	2.3660E-02	1.6000E-04	2,3500E-02	0,0000E+00
52	5,5050E+02	5.0000E-01	2.3590E-02	9.0000E-05	2,3500E-02	0,0000E+00
53	5,8470E+02	5.0000E-01	2.3620E-02	1.2000E-04	2,3500E-02	0,0000E+00
54	6,0610E+02	5.0000E-01	2.3770E-02	2.7000E-04	2,3500E-02	0,0000E+00
55	6,1470E+02	5.0000E-01	2.3640E-02	1.4000E-04	2,3500E-02	0,0000E+00
56	6,2480E+02	5.0000E-01	2.4300E-02	8.0000E-04	2,3500E-02	0,0000E+00
57	6,3250E+02	5.0000E-01	2.3680E-02	1.8000E-04	2,3500E-02	0,0000E+00
58	6,6780E+02	5.0000E-01	2.3730E-02	2.3000E-04	2,3500E-02	0,0000E+00
59	6,7750E+02	5.0000E-01	2.4300E-02	8.0000E-04	2,3500E-02	0,0000E+00
60	6,8110E+02	5.0000E-01	2.3560E-02	6.0000E-05	2,3500E-02	0,0000E+00
61	6,8820E+02	5.0000E-01	2.3590E-02	9.0000E-05	2,3500E-02	0,0000E+00
62	6,9750E+02	5.0000E-01	2.3740E-02	2.4000E-04	2,3500E-02	0,0000E+00
63	7,1250E+02	5.0000E-01	2.4100E-02	6.0000E-04	2,3500E-02	0,0000E+00
64	7,1390E+02	5.0000E-01	2.3750E-02	2.5000E-04	2,3500E-02	0,0000E+00
65	7,2940E+02	5.0000E-01	2.4500E-02	1.0000E-03	2,3500E-02	0,0000E+00
66	7,3480E+02	5.0000E-01	2.3650E-02	1.5000E-04	2,3500E-02	0,0000E+00
67	7,3980E+02	5.0000E-01	2.3600E-02	1.0000E-04	2,3500E-02	0,0000E+00
68	7,4320E+02	5.0000E-01	2.3800E-02	3.0000E-04	2,3500E-02	0,0000E+00
69	7,5600E+02	5.0000E-01	2.3950E-02	4.5000E-04	2,3500E-02	0,0000E+00
70	7,8740E+02	5.0000E-01	2.3880E-02	3.8000E-04	2,3500E-02	0,0000E+00
71	8,0820E+02	5.0000E-01	2.3900E-02	4.0000E-04	2,3500E-02	0,0000E+00
72	8,2880E+02	5.0000E-01	2.3800E-02	3.0000E-04	2,3500E-02	0,0000E+00
73	8,3240E+02	5.0000E-01	2.3660E-02	1.6000E-04	2,3500E-02	0,0000E+00
74	8,4690E+02	5.0000E-01	2.4300E-02	8.0000E-04	2,3500E-02	0,0000E+00
75	8,6000E+02	5.0000E-01	2.3650E-02	1.5000E-04	2,3500E-02	0,0000E+00
76	8,7160E+02	5.0000E-01	2.3600E-02	1.0000E-04	2,3500E-02	0,0000E+00
77	8,9060E+02	5.0000E-01	2.4230E-02	7.3000E-04	2,3500E-02	0,0000E+00
78	9,0950E+02	5.0000E-01	2.4700E-02	1.2000E-03	2,3500E-02	0,0000E+00
79	9,3230E+02	5.0000E-01	2.3700E-02	2.0000E-04	2,3500E-02	0,0000E+00
80	9,4010E+02	5.0000E-01	2.4000E-02	5.0000E-04	2,3500E-02	0,0000E+00
81	9,6230E+02	5.0000E-01	2.3700E-02	2.0000E-04	2,3500E-02	0,0000E+00
82	9,6490E+02	5.0000E-01	2.4000E-02	5.0000E-04	2,3500E-02	0,0000E+00
83	9,7680E+02	5.0000E-01	2.4300E-02	8.0000E-04	2,3500E-02	0,0000E+20
84	9,8560E+02	5.0000E-01	2.3800E-02	3.0000E-04	2,3500E-02	0,0000E+00
85	1,0040E+03	5.0000E-01	2.3710E-02	2.1000E-04	2,3500E-02	0,0000E+00
86	1,0310E+03	5.0000E-01	2.4300E-02	8.0000E-04	2,3500E-02	0,0000E+00
87	1,0470E+03	5.0000E-01	2.4000E-02	5.0000E-04	2,3500E-02	0,0000E+00
88	1,0620E+03	5.0000E-01	2.4400E-02	9.0000E-04	2,3500E-02	0,0000E+00
89	1,0680E+03	5.0000E-01	2.4500E-02	1.0000E-03	2,3500E-02	0,0000E+00
90	1,0710E+03	5.0000E-01	2.3700E-02	2.0000E-04	2,3500E-02	0,0000E+00
91	1,0740E+03	5.0000E-01	2.4200E-02	7.0000E-04	2,3500E-02	0,0000E+00
92	1,0810E+03	5.0000E-01	2.4500E-02	1.0000E-03	2,3500E-02	0,0000E+00
93	1,0940E+03	5.0000E-01	2.4800E-02	1.3000E-03	2,3500E-02	0,0000E+00
94	1,1030E+03	5.0000E-01	2.5400E-02	1.9000E-03	2,3500E-02	0,0000E+00
95	1,1190E+03	5.0000E-01	2.4200E-02	7.0000E-04	2,3500E-02	0,0000E+00
96	1,1500E+03	5.0000E-01	2.3730E-02	2.3000E-04	2,3500E-02	0,0000E+00
97	1,1550E+03	5.0000E-01	2.4300E-02	8.0000E-04	2,3500E-02	0,0000E+00
98	1,1590E+03	5.0000E-01	2.4300E-02	8.0000E-04	2,3500E-02	0,0000E+20
99	1,1850E+03	5.0000E-01	2.3700E-02	2.0000E-04	2,3500E-02	0,0000E+00
100	1,2010E+03	5.0000E-01	2.3950E-02	4.5000E-04	2,3500E-02	0,0000E+00
101	1,2200E+03	5.0000E-01	2.4100E-02	6.0000E-04	2,3500E-02	0,0000E+00
102	1,2300E+03	5.0000E-01	2.4000E-02	5.0000E-04	2,3500E-02	0,0000E+00
103	1,2330E+03	5.0000E-01	2.4100E-02	6.0000E-04	2,3500E-02	0,0000E+00
104	1,2510E+03	5.0000E-01	2.4400E-02	9.0000E-04	2,3500E-02	0,0000E+00
105	1,2600E+03	5.0000E-01	2.3700E-02	2.0000E-04	2,3500E-02	0,0000E+00
106	1,2630E+03	5.0000E-01	2.3800E-02	3.0000E-04	2,3500E-02	0,0000E+00
107	1,2750E+03	5.0000E-01	2.4700E-02	1.2000E-03	2,3500E-02	0,0000E+00
108	1,2850E+03	5.0000E-01	2.3900E-02	4.0000E-04	2,3500E-02	0,0000E+00
109	1,2890E+03	5.0000E-01	2.3800E-02	3.0000E-04	2,3500E-02	0,0000E+00
110	1,3120E+03	5.0000E-01	2.3800E-02	3.0000E-04	2,3500E-02	0,0000E+00
111	1,3250E+03	5.0000E-01	2.3700E-02	2.0000E-04	2,3500E-02	0,0000E+00
112	1,3380E+03	5.0000E-01	2.3720E-02	2.2000E-04	2,3500E-02	0,0000E+00
113	1,3600E+03	5.0000E-01	2.4400E-02	9.0000E-04	2,3500E-02	0,0000E+00
114	1,3860E+03	5.0000E-01	2.4100E-02	6.0000E-04	2,3500E-02	0,0000E+00
115	1,3990E+03	5.0000E-01	2.3600E-02	1.0000E-04	2,3500E-02	0,0000E+00
116	1,4110E+03	5.0000E-01	2.3600E-02	1.0000E-04	2,3500E-02	0,0000E+00
117	1,4160E+03	5.0000E-01	2.6500E-02	3.0000E-03	2,3500E-02	0,0000E+00
118	1,4230E+03	5.0000E-01	2.3800E-02	3.0000E-04	2,3500E-02	0,0000E+00
119	1,4470E+03	5.0000E-01	2.4500E-02	1.0000E-03	2,3500E-02	0,0000E+00
120	1,4550E+03	5.0000E-01	2.3900E-02	4.0000E-04	2,3500E-02	0,0000E+00
121	1,4870E+03	5.0000E-01	2.3950E-02	4.5000E-04	2,3500E-02	0,0000E+00
122	1,5050E+03	5.0000E-01	2.4100E-02	6.0000E-04	2,3500E-02	0,0000E+00
123	1,5100E+03	5.0000E-01	2.4700E-02	1.2000E-03	2,3500E-02	0,0000E+00
124	1,5200E+03	5.0000E-01	2.4100E-02	6.0000E-04	2,3500E-02	0,0000E+00
125	1,5270E+03	5.0000E-01	2.4600E-02	1.1000E-03	2,3500E-02	0,0000E+00
126	1,5350E+03	5.0000E-01	2.4100E-02	6.0000E-04	2,3500E-02	0,0000E+00
127	1,5400E+03	5.0000E-01	2.3570E-02	7.0000E-05	2,3500E-02	0,0000E+00
128	1,5500E+03	5.0000E-01	2.7500E-02	4.0000E-03	2,3500E-02	0,0000E+00
129	1,5550E+03	5.0000E-01	2.4050E-02	5.5000E-04	2,3500E-02	0,0000E+00
130	1,5690E+03	5.0000E-01	2.4700E-02	1.2000E-03	2,3500E-02	0,0000E+00
131	1,5790E+03	5.0000E-01	2.3600E-02	1.0000E-04	2,3500E-02	0,0000E+00

132	1.5910E+03	5.0000E-01	2.5100E-02	1.6000E-03	2.3500E-02	0.0000E+00
133	1.6140E+03	5.0000E-01	2.3900E-02	4.0000E-04	2.3500E-02	0.0000E+00
134	1.6460E+03	5.0000E-01	2.3600E-02	1.0000E-04	2.3500E-02	0.0000E+00
135	1.6730E+03	5.0000E-01	2.3700E-02	2.0000E-04	2.3500E-02	0.0000E+00
136	1.6820E+03	5.0000E-01	2.3900E-02	4.0000E-04	2.3500E-02	0.0000E+00
137	1.6960E+03	5.0000E-01	2.4000E-02	5.0000E-04	2.3500E-02	0.0000E+00
138	1.7190E+03	5.0000E-01	2.4100E-02	6.0000E-04	2.3500E-02	0.0000E+00
139	1.7290E+03	5.0000E-01	2.3600E-02	1.0000E-04	2.3500E-02	0.0000E+00
140	1.7360E+03	5.0000E-01	2.3700E-02	2.0000E-04	2.3500E-02	0.0000E+00
141	1.7450E+03	5.0000E-01	2.5500E-02	2.0000E-03	2.3500E-02	0.0000E+00
142	1.7660E+03	5.0000E-01	2.4000E-02	5.0000E-04	2.3500E-02	0.0000E+00
143	1.7750E+03	5.0000E-01	2.4500E-02	1.0000E-03	2.3500E-02	0.0000E+00
144	1.8040E+03	5.0000E-01	2.4000E-02	5.0000E-04	2.3500E-02	0.0000E+00
145	1.8220E+03	5.0000E-01	2.4600E-02	1.1000E-03	2.3500E-02	0.0000E+00
146	1.8340E+03	5.0000E-01	2.4300E-02	8.0000E-04	2.3500E-02	0.0000E+00
147	1.8550E+03	5.0000E-01	2.3700E-02	2.0000E-04	2.3500E-02	0.0000E+00
148	1.8800E+03	5.0000E-01	2.5300E-02	1.8000E-03	2.3500E-02	0.0000E+00
149	1.8930E+03	5.0000E-01	2.5400E-02	1.9000E-03	2.3500E-02	0.0000E+00
150	1.9130E+03	5.0000E-01	2.8500E-02	5.0000E-03	2.3500E-02	0.0000E+00
151	1.9250E+03	5.0000E-01	2.5100E-02	1.6000E-03	2.3500E-02	0.0000E+00
152	1.9330E+03	5.0000E-01	2.3600E-02	1.0000E-04	2.3500E-02	0.0000E+00
153	1.9420E+03	5.0000E-01	2.4500E-02	1.0000E-03	2.3500E-02	0.0000E+00
154	1.9840E+03	5.0000E-01	2.4300E-02	8.0000E-04	2.3500E-02	0.0000E+00
155	1.9900E+03	5.0000E-01	2.4700E-02	1.2000E-03	2.3500E-02	0.0000E+00
156	2.0000E+03	5.0000E-01	2.4000E-02	5.0000E-04	2.3500E-02	0.0000E+00
157	2.0480E+03	5.0000E-01	2.5500E-02	2.0000E-03	2.3500E-02	0.0000E+00
158	2.0510E+03	5.0000E-01	2.5100E-02	1.6000E-03	2.3500E-02	0.0000E+00
159	2.0630E+03	5.0000E-01	2.3980E-02	4.8000E-04	2.3500E-02	0.0000E+00
160	2.0800E+03	5.0000E-01	2.5800E-02	2.3000E-03	2.3500E-02	0.0000E+00
161	2.1030E+03	5.0000E-01	2.6300E-02	2.8000E-03	2.3500E-02	0.0000E+00
162	2.1140E+03	5.0000E-01	2.4700E-02	1.2000E-03	2.3500E-02	0.0000E+00
163	2.1720E+03	5.0000E-01	2.5700E-02	2.2000E-03	2.3500E-02	0.0000E+00
164	2.1820E+03	5.0000E-01	2.4400E-02	9.0000E-04	2.3500E-02	0.0000E+00
165	2.2370E+03	5.0000E-01	2.3970E-02	4.7000E-04	2.3500E-02	0.0000E+00
166	2.2950E+03	5.0000E-01	2.8000E-02	4.5000E-03	2.3500E-02	0.0000E+00
167	2.3040E+03	5.0000E-01	2.4100E-02	6.0000E-04	2.3500E-02	0.0000E+00
168	2.3270E+03	5.0000E-01	2.4300E-02	8.0000E-04	2.3500E-02	0.0000E+00
169	2.3680E+03	5.0000E-01	2.7500E-02	4.0000E-03	2.3500E-02	0.0000E+00
170	2.3850E+03	5.0000E-01	2.4500E-02	1.0000E-03	2.3500E-02	0.0000E+00
171	2.3960E+03	5.0000E-01	2.7200E-02	3.7000E-03	2.3500E-02	0.0000E+00
172	2.4020E+03	5.0000E-01	2.7200E-02	3.7000E-03	2.3500E-02	0.0000E+00
173	2.4180E+03	5.0000E-01	2.4500E-02	1.0000E-03	2.3500E-02	0.0000E+00
174	2.4360E+03	5.0000E-01	2.4500E-02	1.0000E-03	2.3500E-02	0.0000E+00
175	2.5000E+03	5.0000E-01	2.6600E-02	3.1000E-03	2.3500E-02	0.0000E+00
176	2.5260E+03	5.0000E-01	2.4500E-02	1.0000E-03	2.3500E-02	0.0000E+00
177	2.6060E+03	5.0000E-01	2.6100E-02	2.6000E-03	2.3500E-02	0.0000E+00
178	2.6100E+03	5.0000E-01	2.6100E-02	2.6000E-03	2.3500E-02	0.0000E+00
179	2.6350E+03	5.0000E-01	2.6100E-02	2.6000E-03	2.3500E-02	0.0000E+00
180	2.6480E+03	5.0000E-01	2.4300E-02	8.0000E-04	2.3500E-02	0.0000E+00
181	2.6580E+03	5.0000E-01	2.7000E-02	3.5000E-03	2.3500E-02	0.0000E+00
182	2.6810E+03	5.0000E-01	2.5600E-02	2.1000E-03	2.3500E-02	0.0000E+00
183	2.7010E+03	5.0000E-01	2.5500E-02	2.0000E-03	2.3500E-02	0.0000E+00
184	2.7740E+03	5.0000E-01	2.5500E-02	2.0000E-03	2.3500E-02	0.0000E+00
185	2.7980E+03	5.0000E-01	2.9500E-02	6.0000E-03	2.3500E-02	0.0000E+00
186	2.8110E+03	5.0000E-01	2.9500E-02	6.0000E-03	2.3500E-02	0.0000E+00
187	2.8450E+03	5.0000E-01	2.5600E-02	2.1000E-03	2.3500E-02	0.0000E+00
188	2.9070E+03	5.0000E-01	2.3900E-02	4.0000E-04	2.3500E-02	0.0000E+00
189	2.9180E+03	5.0000E-01	2.9500E-02	6.0000E-03	2.3500E-02	0.0000E+00
190	2.9230E+03	5.0000E-01	3.1500E-02	8.0000E-03	2.3500E-02	0.0000E+00
191	2.9450E+03	5.0000E-01	2.5700E-02	2.2000E-03	2.3500E-02	0.0000E+00
192	3.0730E+03	5.0000E-01	2.4600E-02	1.1000E-03	2.3500E-02	0.0000E+00
193	3.0810E+03	5.0000E-01	2.5700E-02	2.2000E-03	2.3500E-02	0.0000E+00
194	3.0900E+03	5.0000E-01	2.7500E-02	4.0000E-03	2.3500E-02	0.0000E+00
195	3.2370E+03	5.0000E-01	2.5000E-02	1.5000E-03	2.3500E-02	0.0000E+00
196	3.2650E+03	5.0000E-01	3.1500E-02	8.0000E-03	2.3500E-02	0.0000E+00
197	3.3400E+03	5.0000E-01	2.9500E-02	6.0000E-03	2.3500E-02	0.0000E+00
198	3.3470E+03	5.0000E-01	2.6400E-02	2.9000E-03	2.3500E-02	0.0000E+00
199	3.3660E+03	5.0000E-01	2.4600E-02	1.1000E-03	2.3500E-02	0.0000E+00
200	3.3770E+03	5.0000E-01	3.0500E-02	7.0000E-03	2.3500E-02	0.0000E+00
201	3.3990E+03	5.0000E-01	3.0500E-02	7.0000E-03	2.3500E-02	0.0000E+00
202	3.4700E+03	5.0000E-01	2.4700E-02	1.2000E-03	2.3500E-02	0.0000E+00
203	3.5070E+03	5.0000E-01	2.6300E-02	2.8000E-03	2.3500E-02	0.0000E+00
204	3.5190E+03	5.0000E-01	2.6500E-02	3.0000E-03	2.3500E-02	0.0000E+00
205	3.5410E+03	5.0000E-01	2.4700E-02	1.2000E-03	2.3500E-02	0.0000E+00
206	3.5460E+03	5.0000E-01	2.4700E-02	1.2000E-03	2.3500E-02	0.0000E+00
207	3.6000E+03	5.0000E-01	2.6500E-02	3.0000E-03	2.3500E-02	0.0000E+00
208	3.6110E+03	5.0000E-01	2.4500E-02	1.0000E-03	2.3500E-02	0.0000E+00
209	3.6380E+03	5.0000E-01	3.2500E-02	9.0000E-03	2.3500E-02	0.0000E+00
210	3.6530E+03	5.0000E-01	2.6500E-02	3.0000E-03	2.3500E-02	0.0000E+00
211	3.6600E+03	5.0000E-01	2.6500E-02	3.0000E-03	2.3500E-02	0.0000E+00
212	3.6810E+03	5.0000E-01	2.7500E-02	4.0000E-03	2.3500E-02	0.0000E+00
213	3.7420E+03	5.0000E-01	2.6500E-02	3.0000E-03	2.3500E-02	0.0000E+00
214	3.7900E+03	5.0000E-01	2.6500E-02	3.0000E-03	2.3500E-02	0.0000E+00
215	3.8070E+03	5.0000E-01	2.5500E-02	2.0000E-03	2.3500E-02	0.0000E+00
216	3.8260E+03	5.0000E-01	2.9500E-02	6.0000E-03	2.3500E-02	0.0000E+00
217	3.8950E+03	5.0000E-01	3.5500E-02	1.2000E-02	2.3500E-02	0.0000E+00
218	3.9280E+03	5.0000E-01	1.4350E-01	1.2000E-01	2.3500E-02	0.0000E+00
219	3.9770E+03	5.0000E-01	2.6500E-02	3.0000E-03	2.3500E-02	0.0000E+00
220	3.9900E+03	5.0000E-01	2.8500E-02	5.0000E-03	2.3500E-02	0.0000E+00

ISOTOPE-------------------------URANIUM-238
FRACTIONAL ABUNDANCE---------- 1.0000E+00
NUMBER OF ENERGY RANGES------- 2

ENERGY RANGE NUMBER----------- 2
LOWER ENERGY LIMIT (EV)------- 4.0000E+03
UPPER ENERGY LIMIT (EV)------- 4.5000E+04
NUCLEAR SPIN------------------ 0.0000E+00
EFFECTIVE SCATTERING RADIUS--- 9.1840E-01
NUMBER OF L STATES------------ 2

UNRESOLVED SINGLE-LEVEL BREIT-WIGNER PARAMETERS

L VALUE----------------------- 0
NUMBER OF J STATES------------ 1

J-VALUE	DEGREES OF FREEDOM USED IN THE WIDTH DISTRIBUTION: COMPETITIVE	NEUTRON	RADIATION	FISSION
5.0000E-01	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00

INDEX	ENERGY (EV)	LEVEL SPACING	AVERAGE RESONANCE WIDTHS (EV): COMPETITIVE	NEUTRON	RADIATION	FISSION
1	4.0000E+03	2.0000E+01	0.0000E+00	2.1000E-03	2.3500E-02	0.0000E+00
2	4.5000E+03	1.9980E+01	0.0000E+00	2.0979E-03	2.3500E-02	0.0000E+00
3	5.5000E+03	1.9950E+01	0.0000E+00	2.0947E-03	2.3500E-02	0.0000E+00
4	6.5000E+03	1.9920E+01	0.0000E+00	2.0916E-03	2.3500E-02	0.0000E+00
5	7.5000E+03	1.9880E+01	0.0000E+00	2.0874E-03	2.3500E-02	0.0000E+00
6	8.5000E+03	1.9840E+01	0.0000E+00	2.0832E-03	2.3500E-02	0.0000E+00
7	1.0000E+04	1.9800E+01	0.0000E+00	2.0790E-03	2.3500E-02	0.0000E+00
8	1.2000E+04	1.9710E+01	0.0000E+00	2.0695E-03	2.3500E-02	0.0000E+00
9	1.5000E+04	1.9610E+01	0.0000E+00	2.0590E-03	2.3500E-02	0.0000E+00
10	2.0000E+04	1.9440E+01	0.0000E+00	2.0412E-03	2.3500E-02	0.0000E+00
11	2.5000E+04	1.9260E+01	0.0000E+00	2.0223E-03	2.3500E-02	0.0000E+00
12	3.0000E+04	1.9090E+01	0.0000E+00	2.0044E-03	2.3500E-02	0.0000E+00
13	3.5000E+04	1.8920E+01	0.0000E+00	1.9866E-03	2.3500E-02	0.0000E+00
14	4.0000E+04	1.8750E+01	0.0000E+00	1.9687E-03	2.3500E-02	0.0000E+00
15	4.5000E+04	1.8590E+01	0.0000E+00	1.9519E-03	2.3500E-02	0.0000E+00

L VALUE----------------------- 1
NUMBER OF J STATES------------ 2

J-VALUE	DEGREES OF FREEDOM USED IN THE WIDTH DISTRIBUTION: COMPETITIVE	NEUTRON	RADIATION	FISSION
5.0000E-01	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00

INDEX	ENERGY (EV)	LEVEL SPACING	AVERAGE RESONANCE WIDTHS (EV): COMPETITIVE	NEUTRON	RADIATION	FISSION
1	4.0000E+03	2.0000E+01	0.0000E+00	3.0269E-03	2.3500E-02	0.0000E+00
2	4.5000E+03	1.9980E+01	0.0000E+00	3.1672E-03	2.3500E-02	0.0000E+00
3	5.5000E+03	1.9950E+01	0.0000E+00	3.2424E-03	2.3500E-02	0.0000E+00
4	6.5000E+03	1.9920E+01	0.0000E+00	3.2073E-03	2.3500E-02	0.0000E+00
5	7.5000E+03	1.9880E+01	0.0000E+00	2.9739E-03	2.3500E-02	0.0000E+00
6	8.5000E+03	1.9840E+01	0.0000E+00	2.7591E-03	2.3500E-02	0.0000E+00
7	1.0000E+04	1.9800E+01	0.0000E+00	3.0997E-03	2.3500E-02	0.0000E+00
8	1.2000E+04	1.9710E+01	0.0000E+00	3.0109E-03	2.3500E-02	0.0000E+00
9	1.5000E+04	1.9610E+01	0.0000E+00	3.0944E-03	2.3500E-02	0.0000E+00
10	2.0000E+04	1.9440E+01	0.0000E+00	2.9362E-03	2.3500E-02	0.0000E+00
11	2.5000E+04	1.9260E+01	0.0000E+00	2.9895E-03	2.3500E-02	0.0000E+00
12	3.0000E+04	1.9090E+01	0.0000E+00	2.8398E-03	2.3500E-02	0.0000E+00
13	3.5000E+04	1.8920E+01	0.0000E+00	2.7951E-03	2.3500E-02	0.0000E+00
14	4.0000E+04	1.8750E+01	0.0000E+00	2.8279E-03	2.3500E-02	0.0000E+00
15	4.5000E+04	1.8590E+01	0.0000E+00	2.9299E-03	2.3500E-02	0.0000E+00

	DEGREES OF FREEDOM USED IN THE WIDTH DISTRIBUTION			
J=VALUE	COMPETITIVE	NEUTRON	RADIATION	FISSION
1.5000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00

				AVERAGE RESONANCE WIDTHS (EV)		
INDEX	ENERGY (EV)	LEVEL SPACING	COMPETITIVE	NEUTRON	RADIATION	FISSION
1	4.0000E+03	1.0983E+01	0.0000E+00	1.6622E-03	2.3500E-02	0.0000E+00
2	4.5000E+03	1.0972E+01	0.0000E+00	1.7392E-03	2.3500E-02	0.0000E+00
3	5.5000E+03	1.0955E+01	0.0000E+00	1.7805E-03	2.3500E-02	0.0000E+00
4	6.5000E+03	1.0939E+01	0.0000E+00	1.7613E-03	2.3500E-02	0.0000E+00
5	7.5000E+03	1.0917E+01	0.0000E+00	1.6331E-03	2.3500E-02	0.0000E+00
6	8.5000E+03	1.0895E+01	0.0000E+00	1.5151E-03	2.3500E-02	0.0000E+00
7	1.0000E+04	1.0873E+01	0.0000E+00	1.7022E-03	2.3500E-02	0.0000E+00
8	1.2000E+04	1.0824E+01	0.0000E+00	1.6534E-03	2.3500E-02	0.0000E+00
9	1.5000E+04	1.0769E+01	0.0000E+00	1.6992E-03	2.3500E-02	0.0000E+00
10	2.0000E+04	1.0675E+01	0.0000E+00	1.6124E-03	2.3500E-02	0.0000E+00
11	2.5000E+04	1.0576E+01	0.0000E+00	1.6417E-03	2.3500E-02	0.0000E+00
12	3.0000E+04	1.0483E+01	0.0000E+00	1.5594E-03	2.3500E-02	0.0000E+00
13	3.5000E+04	1.0390E+01	0.0000E+00	1.5349E-03	2.3500E-02	0.0000E+00
14	4.0000E+04	1.0296E+01	0.0000E+00	1.5529E-03	2.3500E-02	0.0000E+00
15	4.5000E+04	1.0209E+01	0.0000E+00	1.6089E-03	2.3500E-02	0.0000E+00

URANIUM-238 FISSION NEUTRON CROSS SECTION ENDF/B MATERIAL NO. 6262

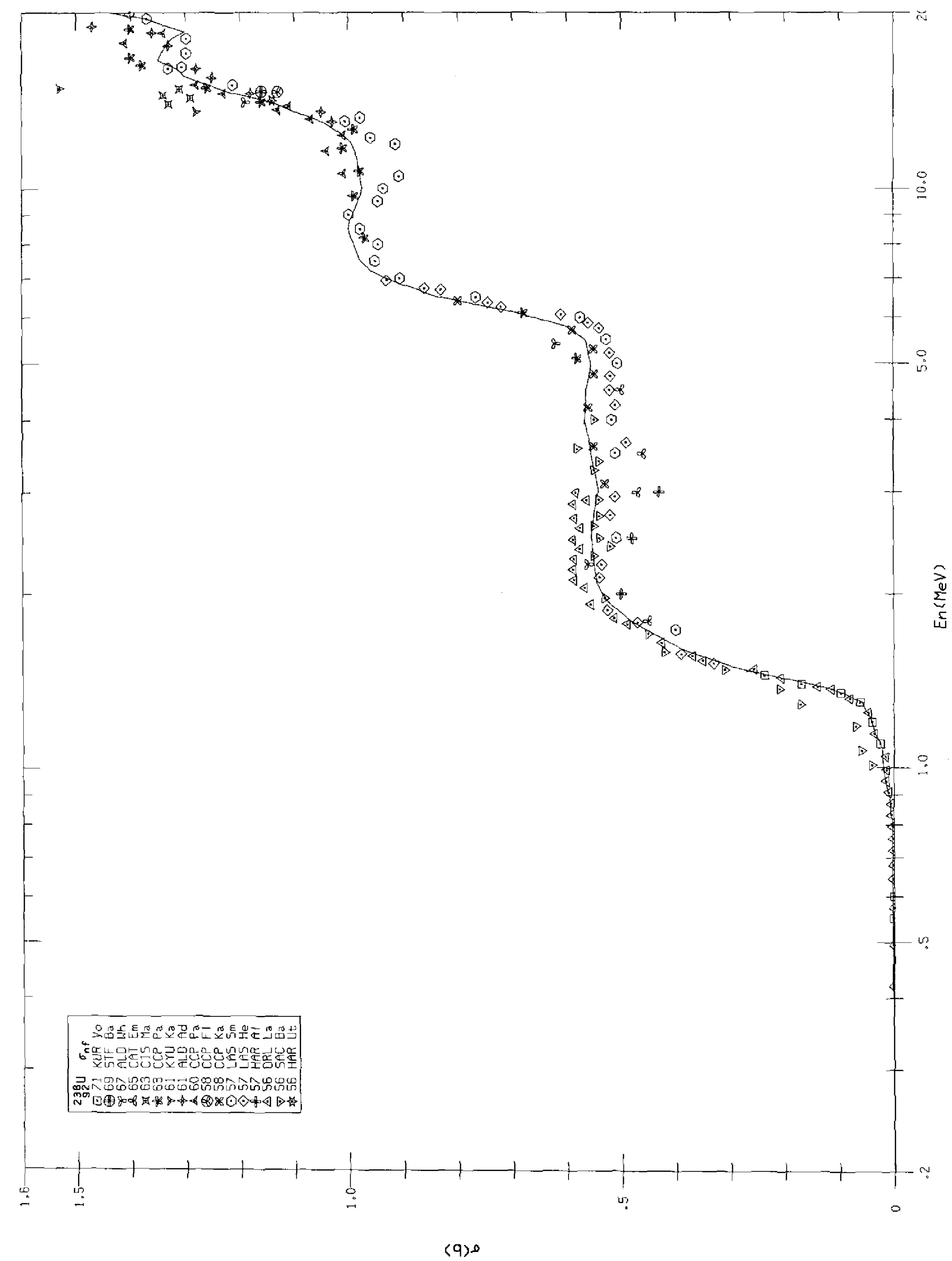
REACTION Q VALUE 1,9400E+08 EV

INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION
1 TO 90	Y LINEAR IN X

NEUTRON CROSS SECTIONS

INDEX,	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	1,0000E-05	0,0000E+00	8,5000E+03	0.0000E+00	1,0000E+04	8,7000E-05	2,0000E+04	8,7000E-05	3,0000E+04	8,7000E-05
6	4,0000E+04	4,0000E-05	5,0000E+04	4,0000E-05	6,0000E+04	4,0000E-05	7,0000E+04	4.0000E-05	8,0000E+04	4,0000E-05
11	9,0000E+04	4,0000E-05	1,0000E+05	4,0000E-05	3,0000E+05	7,0000E-05	4.0000E+05	1.2200E-04	5,0000E+05	2,3400E-04
16	5,7500E+05	5,6600E-04	6,1000E+05	1.2400E-03	7,0000E+05	1,3400E-03	7,5000E+05	1.9850E-03	8,0000E+05	3,1160E-03
21	8,5000E+05	5,8710E-03	8,9000E+05	8,7160E-03	9,2000E+05	1,2785E-02	9,5000E+05	1.6302E-02	9,7000E+05	1,6093E-02
26	1,0000E+06	1,6170E-02	1,0500E+06	1.8119E-02	1,1000E+06	2,3500E-02	1,1500E+06	3,4892E-02	1,2000E+06	4,0491E-02
31	1,2500E+06	4,2599E-02	1,3000E+06	5,7725E-02	1,3500E+06	9,3289E-02	1,4000E+06	1.5125E-01	1,4500E+06	2,2857E-01
36	1,5000E+06	2,9387E-01	1,6000E+06	3,8228E-01	1,7000E+06	4,3693E-01	1,8000E+06	4,8146E-01	1,9000E+06	5,1369E-01
41	2,0000E+06	5,3508E-01	2,1000E+06	5.4519E-01	2,5000E+06	5,5480E-01	2,7500E+06	5,4980E-01	3,0000E+06	5,4199E-01
46	3,1000E+06	5,4126E-01	3,5000E+06	5,5483E-01	4,0000E+06	5,6580E-01	4,5000E+06	5,6336E-01	5,0000E+06	5,5466E-01
51	5,2000E+06	5,5955E-01	5,4000E+06	5,6261E-01	5,5000E+06	5,6551E-01	5,8000E+06	6,0356E-01	6,0000E+06	6,6120E-01
56	6,2000E+06	7,2318E-01	6,5000E+06	8,3517E-01	6,8000E+06	8,9700E-01	7.0000E+06	9,3000E-01	7,2000E+06	9,5700E-01
61	7,5000E+06	9,7800E-01	8,0000E+06	9,9000E-01	8,2500E+06	9,9600E-01	8,5000E+06	1,0000E+00	8,7500E+06	9,9700E-01
66	9,0000E+06	9,9200E-01	9,2500E+06	9,8700E-01	9,5000E+06	9,8200E-01	9,7500E+06	9,7700E-01	1,0000E+07	9,7400E-01
71	1,0500E+07	9,7800E-01	1,1000E+07	9,8300E-01	1,1500E+07	9,8700E-01	1,2000E+07	9,9500E-01	1,2500E+07	1,0190E+00
76	1,3000E+07	1,0480E+00	1,3500E+07	1,0980E+00	1,4000E+07	1,1400E+00	1,4500E+07	1,2100E+00	1,5000E+07	1,2599E+00
81	1,5500E+07	1,2992E+00	1,6000E+07	1,3157E+00	1,6500E+07	1,3493E+00	1,7000E+07	1,3438E+00	1,7500E+07	1,3330E+00
86	1,8000E+07	1,3237E+00	1,8500E+07	1,3000E+00	1,9000E+07	1,2978E+00	1,9500E+07	1,3748E+00	2,0000E+07	1,4350E+00



238 92 U σnf
71 KUR Yo
69 STF Ba
67 ALD Wh
65 CAT Em
63 CIS Ma
63 CCP Pa
61 KYU Ka
61 ALD Ad
60 CCP Pa
58 CCP Ft
58 CCP Ka
57 LAS Sm
57 LAS He
57 HAR Af
56 ORL La
56 SAC Ba
56 HAR Ut
σ(b)
En(MeV)

REFERENCES FOR EXPERIMENTAL DATA

$^{238}U(n,f)$

Yr.	Lab	Author	References
71	KUR	Vorotnikov, et al.	Jad. Fiz. Iss. 12, 22 (1971)
69	STF	Barrall, et al.	AFWL-TR-68-134 (1969)
67	ALD	White, et al.	J. Nuc. En. 21, 671 (1967)
65	CAT	Emma, et al.	Nuc. Phys. 63, 641 (1965)
63	CIS	Mangialajo, et al.	Nuc. Phys. 43, 124 (1963)
63	CCP	Pankratov	At. En. 14, 177 (1963)
61	KYU	Katase	Priv. Comm. (1961)
61	ALD	Adams, et al.	J. Nuc. En. 14, 85 (1961)
60	CCP	Pankratov, et al.	At. En. 9, 399 (1960)
58	CCP	Flerov, et al.	At. En. 5, 657 (1958)
58	CCP	Kalanin, et al.	Second Peaceful Uses of At. En. Conf. Geneva Vol 16, 136 (1958)
57	LAS	Smith, et al.	Bull. Am. Phys. Soc. 2, 196 (1957)
57	LAS	Henkel	LA-2122 (1957)
57	HAR	Allen, et al.	Proc. Phys. Soc./A 70, 573 (1957)
56	ORL	Lamphere	Phys. Rev. 104, 1654 (1956)
56	SAC	Ballini, et al.	Priv. Comm. Netter (1956)
56	HAR	Uttley, et al.	AERE NP/R-1996 (1956)

URANIUM-238 (N,GAMMA) NEUTRON CROSS SECTION ENDF/B MATERIAL NO. 6262

REACTION Q VALUE 4.8044E+06 EV

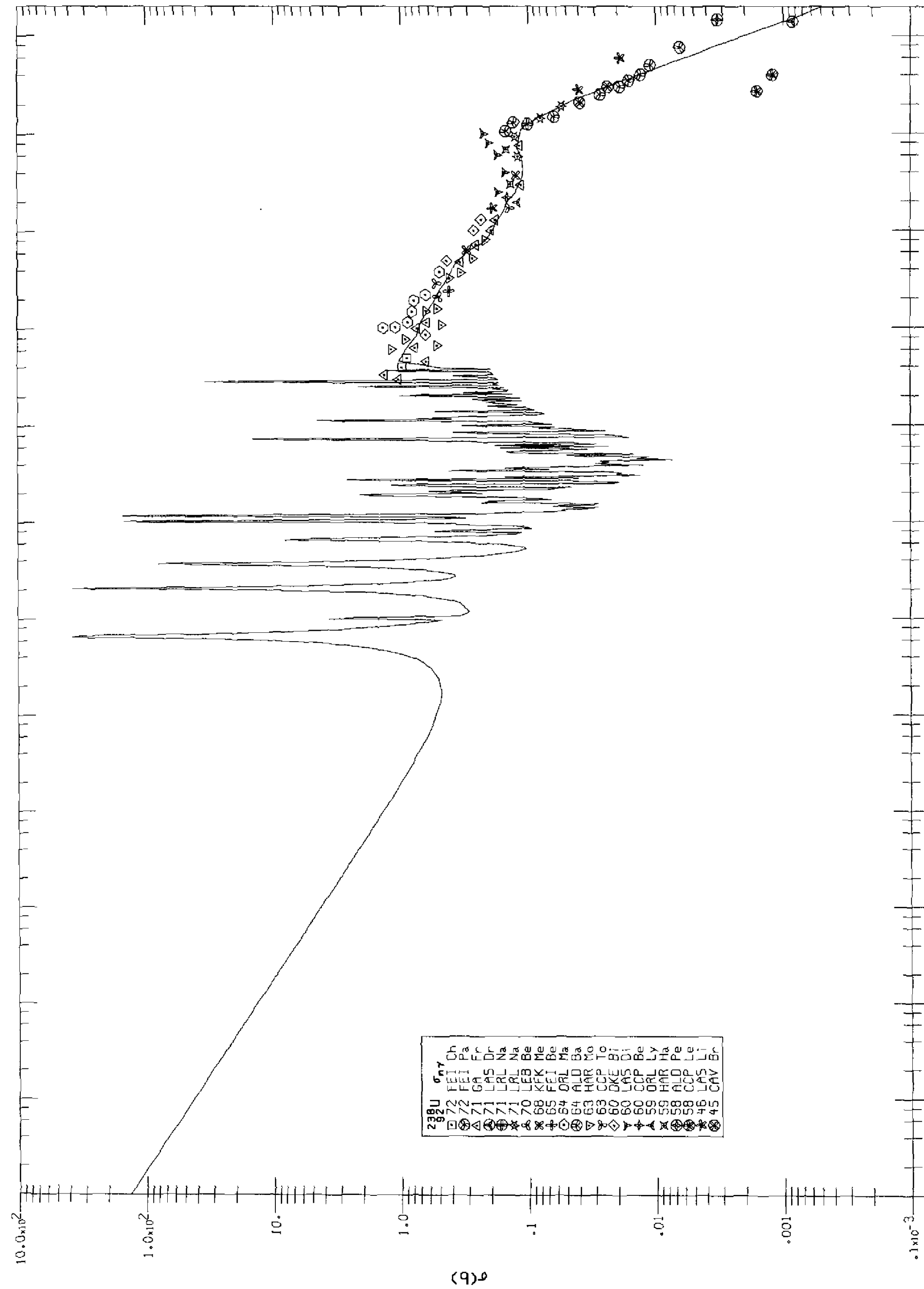
INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION	RANGE	DESCRIPTION	RANGE	DESCRIPTION
1 TO 186	LN Y LINEAR IN LN X	186 TO 214	Y LINEAR IN X	214 TO 263	LN Y LINEAR IN LN X

NEUTRON CROSS SECTIONS

INDEX,	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	1.0000E-05	1.3519E+02	1.0000E-04	4.2752E+01	1.2000E-04	3.9027E+01	1.4000E-04	3.6132E+01	1.6000E-04	3.3799E+01
6	1.8000E-04	3.1866E+01	2.0000E-04	3.0231E+01	2.2000E-04	2.8824E+01	2.4000E-04	2.7597E+01	2.5300E-04	2.6879E+01
11	2.6000E-04	2.6514E+01	2.8000E-04	2.5550E+01	3.0000E-04	2.4684E+01	3.2000E-04	2.3900E+01	3.4000E-04	2.3187E+01
16	3.6000E-04	2.2533E+01	3.8000E-04	2.1932E+01	4.0000E-04	2.1377E+01	4.2000E-04	2.0862E+01	4.4000E-04	2.0382E+01
21	4.6000E-04	1.9935E+01	4.8000E-04	1.9515E+01	5.0000E-04	1.9121E+01	5.2000E-04	1.8749E+01	5.4000E-04	1.8399E+01
26	5.6000E-04	1.8068E+01	5.8000E-04	1.7753E+01	6.0000E-04	1.7455E+01	6.2000E-04	1.7171E+01	6.4000E-04	1.6901E+01
31	6.6000E-04	1.6643E+01	6.8000E-04	1.6396E+01	7.0000E-04	1.6161E+01	7.2000E-04	1.5935E+01	7.4000E-04	1.5718E+01
36	7.6000E-04	1.5510E+01	7.8000E-04	1.5310E+01	8.0000E-04	1.5117E+01	8.2000E-04	1.4932E+01	8.4000E-04	1.4753E+01
41	8.6000E-04	1.4580E+01	8.8000E-04	1.4414E+01	9.0000E-04	1.4253E+01	9.2000E-04	1.4097E+01	9.4000E-04	1.3946E+01
46	9.6000E-04	1.3800E+01	9.8000E-04	1.3659E+01	1.0000E-03	1.3522E+01	1.2000E-03	1.2344E+01	1.4000E-03	1.1429E+01
51	1.6000E-03	1.0691E+01	1.8000E-03	1.0080E+01	2.0000E-03	9.5629E+00	2.2000E-03	9.1182E+00	2.4000E-03	8.7303E+00
56	2.5300E-03	8.5033E+00	2.6000E-03	8.3881E+00	2.8000E-03	8.0833E+00	3.0000E-03	7.8095E+00	3.2000E-03	7.5618E+00
61	3.4000E-03	7.3363E+00	3.6000E-03	7.1298E+00	3.8000E-03	6.9399E+00	4.0000E-03	6.7644E+00	4.2000E-03	6.6016E+00
66	4.4000E-03	6.4501E+00	4.6000E-03	6.3085E+00	4.8000E-03	6.1759E+00	5.0000E-03	6.0514E+00	5.2000E-03	5.9341E+00
71	5.4000E-03	5.8234E+00	5.6000E-03	5.7186E+00	5.8000E-03	5.6194E+00	6.0000E-03	5.5251E+00	6.2000E-03	5.4355E+00
76	6.4000E-03	5.3501E+00	6.6000E-03	5.2686E+00	6.8000E-03	5.1907E+00	7.0000E-03	5.1162E+00	7.2000E-03	5.0448E+00
81	7.4000E-03	4.9763E+00	7.6000E-03	4.9106E+00	7.8000E-03	4.8474E+00	8.0000E-03	4.7866E+00	8.2000E-03	4.7280E+00
86	8.4000E-03	4.6716E+00	8.6000E-03	4.6171E+00	8.8000E-03	4.5645E+00	9.0000E-03	4.5137E+00	9.2000E-03	4.4645E+00
91	9.4000E-03	4.4169E+00	9.6000E-03	4.3708E+00	9.8000E-03	4.3261E+00	1.0000E-02	4.2828E+00	1.2000E-02	3.9111E+00
96	1.4000E-02	3.6222E+00	1.6000E-02	3.3895E+00	1.8000E-02	3.1968E+00	2.0000E-02	3.0339E+00	2.2000E-02	2.8937E+00
101	2.4000E-02	2.7715E+00	2.5300E-02	2.7000E+00	2.6000E-02	2.6637E+00	2.8000E-02	2.5678E+00	3.0000E-02	2.4816E+00
106	3.2000E-02	2.4037E+00	3.4000E-02	2.3327E+00	3.6000E-02	2.2678E+00	3.8000E-02	2.2081E+00	4.0000E-02	2.1530E+00
111	4.2000E-02	2.1019E+00	4.4000E-02	2.0543E+00	4.6000E-02	2.0099E+00	4.8000E-02	1.9683E+00	5.0000E-02	1.9292E+00
116	5.2000E-02	1.8924E+00	5.4000E-02	1.8577E+00	5.6000E-02	1.8249E+00	5.8000E-02	1.7938E+00	6.0000E-02	1.7643E+00
121	6.2000E-02	1.7362E+00	6.4000E-02	1.7095E+00	6.6000E-02	1.6840E+00	6.8000E-02	1.6597E+00	7.0000E-02	1.6364E+00
126	7.2000E-02	1.6141E+00	7.4000E-02	1.5927E+00	7.6000E-02	1.5722E+00	7.8000E-02	1.5525E+00	8.0000E-02	1.5335E+00
131	8.2000E-02	1.5152E+00	8.4000E-02	1.4976E+00	8.6000E-02	1.4807E+00	8.8000E-02	1.4643E+00	9.0000E-02	1.4484E+00
136	9.2000E-02	1.4331E+00	9.4000E-02	1.4183E+00	9.6000E-02	1.4040E+00	9.8000E-02	1.3901E+00	1.0000E-01	1.3766E+00
141	1.2000E-01	1.2613E+00	1.4000E-01	1.1721E+00	1.6000E-01	1.1004E+00	1.8000E-01	1.0414E+00	2.0000E-01	9.9164E-01
146	2.2000E-01	9.4905E-01	2.4000E-01	9.1208E-01	2.5300E-01	8.9053E-01	2.6000E-01	8.7963E-01	2.8000E-01	8.5087E-01
151	3.0000E-01	8.2517E-01	3.2000E-01	8.0205E-01	3.4000E-01	7.8112E-01	3.6000E-01	7.6207E-01	3.8000E-01	7.4464E-01
156	4.0000E-01	7.2864E-01	4.2000E-01	7.1388E-01	4.4000E-01	7.0024E-01	4.6000E-01	6.8757E-01	4.8000E-01	6.7579E-01
161	5.0000E-01	6.6480E-01	5.2000E-01	6.5453E-01	5.4000E-01	6.4490E-01	5.6000E-01	6.3587E-01	5.8000E-01	6.2737E-01
166	6.0000E-01	6.1937E-01	6.2000E-01	6.1183E-01	6.4000E-01	6.0470E-01	6.6000E-01	5.9796E-01	6.8000E-01	5.9158E-01
171	7.0000E-01	5.8553E-01	7.2000E-01	5.7979E-01	7.4000E-01	5.7434E-01	7.6000E-01	5.6917E-01	7.8000E-01	5.6425E-01
176	8.0000E-01	5.5956E-01	8.2000E-01	5.5510E-01	8.4000E-01	5.5086E-01	8.6000E-01	5.4681E-01	8.8000E-01	5.4295E-01
181	9.0000E-01	5.3927E-01	9.2000E-01	5.3576E-01	9.4000E-01	5.3241E-01	9.6000E-01	5.2922E-01	9.8000E-01	5.2616E-01
186	1.0000E+00	5.2325E-01	1.0000E+00	2.7688E-02	2.0000E+00	1.9163E-02	3.0000E+00	1.5311E-02	4.0000E+00	1.2981E-02
191	5.0000E+00	1.1375E-02	1.0000E+01	7.2860E-03	1.0000E+02	0.0000E+00	6.8000E+02	0.0000E+00	7.0000E+02	5.0000E-03
196	9.8000E+02	2.0000E-02	1.0000E+03	5.0000E-02	2.0000E+03	1.1000E-01	2.1000E+03	1.2000E-01	2.5000E+03	1.5000E-01
201	3.0000E+03	1.7000E-01	4.0000E+03	1.9000E-01	4.0000E+03	0.0000E+00	8.5000E+03	0.0000E+00	1.2000E+04	5.0000E-03
206	1.5000E+04	7.0000E-03	2.0000E+04	1.0000E-02	2.5000E+04	1.4000E-02	3.0000E+04	1.8000E-02	3.5000E+04	2.3000E-02
211	4.0000E+04	2.7000E-02	4.4900E+04	3.2000E-02	4.5000E+04	3.2000E-02	4.5000E+04	3.7300E-01	4.7500E+04	3.5700E-01
216	5.0000E+04	3.4200E-01	5.5000E+04	3.2100E-01	6.0000E+04	2.9500E-01	6.5000E+04	2.7600E-01	7.0000E+04	2.4700E-01
221	7.5000E+04	2.2500E-01	8.0000E+04	2.1500E-01	8.5000E+04	2.0500E-01	9.0000E+04	1.9800E-01	9.5000E+04	1.9200E-01
226	1.0000E+05	1.9000E-01	1.1000E+05	1.8200E-01	1.2500E+05	1.7200E-01	1.5700E+05	1.5500E-01	1.7000E+05	1.5000E-01
231	2.0000E+05	1.4300E-01	2.3000E+05	1.3000E-01	2.5000E+05	1.2400E-01	2.9000E+05	1.1700E-01	3.3000E+05	1.1100E-01
236	3.8000E+05	1.0800E-01	4.5000E+05	1.0700E-01	5.6000E+05	1.1100E-01	6.2000E+05	1.1300E-01	7.2000E+05	1.2000E-01
241	7.8000E+05	1.2200E-01	9.0000E+05	1.2200E-01	1.0000E+06	1.2000E-01	1.1000E+06	1.1200E-01	1.2000E+06	1.0500E-01

246	1,4000E+06	8,7500E-02	1,5000E+06	8,0000E-02	1,8000E+06	6,0000E-02	2,0000E+06	5,1000E-02	2,2000E+06	4,3000E-02
251	2,5000E+06	3,4500E-02	3,0000E+06	2,4000E-02	3,6000E+06	1,6500E-02	4,0000E+06	1,3300E-02	5,0000E+06	8,3700E-03
256	6,0000E+06	5,7400E-03	7,0000E+06	4,1800E-03	8,0000E+06	3,1700E-03	9,0000E+06	2,4900E-03	1,0000E+07	2,0000E-03
261	1,2000E+07	1,3700E-03	1,4000E+07	1,0000E-03	2,0000E+07	4,7910E-04				



238 92 U σnγ
72 FEI Ch
72 FEI Pa
71 GA Fr
71 LAS Dr
71 LRL Na
71 LRL Na
70 LEB Be
68 KFK Me
65 FEI Be
64 ORL Ma
64 ALD Ba
63 HAR Mo
63 CCP To
60 DKE Bi
60 LAS Di
60 CCP Be
59 ORL Ly
59 HAR Ha
58 ALD Pe
58 CCP Le
46 LAS Li
45 CAV Br
En(eV)
σ(b)

REFERENCES FOR EXPERIMENTAL DATA

$^{238}U(n,\gamma)$

Yr.	Lab	Author	References
72	FEI	Chelnokov	Jad. Fiz. Iss 13, 6 (1972)
72	FEI	Panitkin, et al.	At. En. 33, 762 (1972)
71	GA	Fricke, et al.	Third Conf. Neutron Cross Sections &Tech., Knoxville, Tenn. Vol I, 252 (1971)
71	LAS	Drake, et al.	Phys. Lett./B 36, 557 (1971)
71	LRL	Nagle, et al.	Third Conf. Neutron Cross Sections &Tech., Knoxville, Tenn. Vol II 259 (1971)
70	LEB	Bergman, et al.	I.C.D. (Obninsk) 6, 32 (1970)
68	KFK	Menlove, et al.	Nuc. Sci.&Eng. 33, 24 (1968)
65	FEI	Belanova, et al.	At. En. 19, 3 (1965)
64	ORL	Macklin	Priv. Comm. (1964)
64	ALD	Barry, et al.	J. Nuc. En. 18, 481 (1964)
63	HAR	Moxon, et al.	TRDWP/P-8 (1963)
63	CCP	Tolstikov, et al.	At. En. 15, 414 (1963)
60	DUK	Bilpuch, et al	An. Phys. 10, 455 (1960)
60	LAS	Diven, et al.	Phys. Rev. 120, 556 (1960)
60	CCP	Belanova	At. En. 8, 549 (1960)
59	ORL	Lyons, et al.	Phys. Rev. 114, 619 (1959)
59	HAR	Hanna, et al.	J. Nuc. En. 8, 197 (1959)
58	ALD	Perkin, et al.	Proc. Phys. Soc. 72, 505 (1958)
58	CCP	Leipunsky, et al	Second Peaceful Uses of At. En. Conf. Geneva Vol 15, 50 (1958)
46	LAS	Linnenberger, et al.	LA-467 (1946)
45	CAV	Broda, et al.	BR-574 (1945)

```
93-NP-237 ANC,LASL   EVAL-JUN73 J.R.SMITH (ANC), W.E.STEIN (LASL)
                     DIST-MAY74
*         *          *          *          *          *          *
 P.C. TO NORMALIZATION AND STANDARDS SUBCOMMITTEE MARCH 1974
 PERTINENT HOLLORITH FROM GENERAL FILE FOLLOWS (MAT 1263)
 ALL REFERENCES CARRIED OVER FROM GENERAL FILE
237-NEPTUNIUM      EVALUATED JUNE 1973 BY J.R.SMITH (AEROJET
           NUCLEAR CO) AND W.E.STEIN (LOS ALAMOS)
*         *          *          *          *          *          *
THE BASIC CHANGES FROM THE VERSION III EVALUATION ARE:
   1. A NEW FISSION EVALUATION BY W.E.STEIN, FROM 4Ø KEV TO
      2Ø MEV.
   2. NEW RESONANCE PARAMETERS, BOTH RESOLVED AND UNRESOLVED
   3. REVISED CAPTURE CROSS SECTIONS.
   4. RENORMALIZED (N,2N)AND (N,3N) DATA.
   5. READJUSTMENT  OF THE INELASTIC CROSS SECTIONS TO
      ACCOMMODATE THE ABOVE CHANGES.
FILES I, IV, AND V  AND THE LOW ENERGY POINTWISE DATA IN
FILE III ARE UNCHANGED.
          CROSS SECTION VALVES AT E=Ø.Ø253 EV ARE:
              TOTAL        186.63 BARNS
              SCATTER       17.51 BARNS
              CAPTURE      169.1Ø BARNS
              FISSION       16.63 MILLIBARNS
   MT=18  BELOW Ø.3 EV THE FISSION CROSS SECTION IS GIVEN BY
          THE SAME POINTWISE FILE THAT WAS USED IN VERSION III.
          THE FISSION CROSS SECTION AT Ø.Ø253 EV IS 16.63 MB.
          ABOVE 4Ø KEV THE FISSION CROSS SECTION HAS BEEN
          REEVALUATED BY W.E.STEIN.  THE EVALUATION FOLLOWED
          WHITE ET AL (14) FROM 4Ø TO 5Ø5 KEV, KLEMA(15)(RENORM)
          TO 1.Ø MEV, STEIN(16), 1.Ø TO 4.5 MEV, AND PANKRATOV
          (17), 4.5 TO 2Ø MEV, NORMALIZED TO WHITE AND
          WARNER(18).  THE ESTIMATED ERRORS IN THE FISSION
          CROSS SECTION ARE AS FOLLOWS:
                    ENERGY RANGE     STANDARD ERROR
                       (MEV)           (PER CENT)
                    RES. RANGE            5Ø
                 Ø.Ø4Ø<E<Ø.5Ø5            1Ø
                       Ø.5Ø5               5
                 Ø.5Ø5<E<1.Ø              1Ø
                   1.Ø<E<5.4               3
                   5.4<E<14.1             1Ø
                       14.1                4
                  14.1<E<2Ø.Ø             1Ø
                      *** REFERENCES ***
```


```
          1. G.E.HANSEN, QUOTED IN R.B.LEACHMAN, P/665, PROC 2ND
             UN CONF ON PUAE (1958)
          2. B.D.KUZMINOV ET AL. SOV JOURN AT ENERGY VOL 4, P25Ø
             (1958)
          3. V.I.LEBEDEV, V.I.KALASHNIKOVA, SOV JOURN AT ENERGY
```

VOL 10, P357 (1961)
4. L.D.GORDEEVA, G.N.SMIRENKIN, SOV JOURN AT ENERGY, V108, P783 (1957)
5. N.E.HOLDEN, CHART OF THE NUCLIDES, 11TH ED (1973)
6. R.S.IYER ET AL, PHYS AND CHEM OF FISSION, VOL 1, P439, IAEA,VIENNA (1965)
7. G.P.FORD AND J.S.GILMORE, LA-1997 (1956)
8. D.PAYA, THESIS, UNIVERSITY OF PARIS-SOUTH, CENTER D-ORSAY (1972)
9. E.PENNINGTON, PRIVATE COMMUNICATION
10. R.C.BLOCK, PRIVATE COMMUNICATION
11. D.T.GOLDMAN, TRANS AM NUCL SOC, VOL 7, P84 (1964)
12. S.PEARLSTEIN, NUCL SCI ENGR, VOL 23, P238(1965)
13. J.H.LANDRUM ET AL, UCRL-74262 (1972)
14. P.H.WHITE ET AL, PHYS AND CHEM OF FISSION, P219, IAEA, SALZBURG (1965)
15 E.D.KLEMA, PHYS REV VOL 72, P88 (1947)
16. W.E.STEIN ET AL, CONF-660303, P623, WASHINGTON 1966
17. V.M. PANKRATOV, SOV JOURN ATOMIC ENERGY, VOL 14, P.197 (1963)
18. P.H.WHITE AND G.P.WARNER, J NUCL ENERGY VOL 21, P671 (1967)
19 J.J.NAGLE ET AL, CONF-710301, V1, P259, KNOXVILLE (1971)
20 J.TERRELL, PHYS & CHEM OF FISSION, VOL2, P3, IAEA, VIENNA (1965)

NEPTUNIUM-237

ENDF/B MATERIAL NO. 6263
TABLE OF CONTENTS
GENERAL INFORMATION

NEPTUNIUM-237

ENDF/B MATERIAL NO. 6263
RESONANCE DATA
RESONANCE PARAMETERS

ISOTOPE----------------------NEPTUNIUM-237
FRACTIONAL ABUNDANCE---------- 1.0000E+00
NUMBER OF ENERGY RANGES------- 2

ENERGY RANGE NUMBER----------- 1
LOWER ENERGY LIMIT (EV)------ 3.0000E-01
UPPER ENERGY LIMIT (EV)------ 1.3000E+02
NUCLEAR SPIN----------------- 2.5000E+00
SPIN SCATTERING LENGTH (A+)-- 9.1410E-01
NUMBER OF L STATES----------- 1

RESOLVED SINGLE-LEVEL BREIT-WIGNER PARAMETERS

L VALUE---------------------- 0
NUMBER OF RESONANCES--------- 170
SPIN SCATTERING LENGTH (A-)-- 0.0000E+00

INDEX	ENERGY (EV)	J VALUE	RESONANCE WIDTHS (EV) TOTAL	NEUTRON	RADIATION	FISSION
1	-2.5000E+00	2.5000E+00	4.0957E-02	8.9546E-03	3.2000E-02	2.7700E-06
2	-2.2200E-01	2.5000E+00	3.2041E-02	3.7693E-05	3.2000E-02	3.5000E-06
3	4.9000E-01	2.5000E+00	3.3034E-02	3.2550E-05	3.3000E-02	1.2400E-06
4	1.3200E+00	2.5000E+00	3.9841E-02	3.7340E-05	3.9800E-02	3.4900E-06
5	1.4800E+00	2.5000E+00	4.8346E-02	1.4501E-04	4.8200E-02	9.8000E-07
6	1.9700E+00	2.5000E+00	4.1219E-02	1.6562E-05	4.1200E-02	2.3600E-06
7	3.8600E+00	2.5000E+00	4.1648E-02	2.4401E-04	4.1400E-02	3.7100E-06
8	4.2600E+00	2.5000E+00	3.7528E-02	2.6419E-05	3.7500E-02	1.8800E-06
9	4.8600E+00	2.5000E+00	3.8735E-02	3.4391E-05	3.8700E-02	5.9000E-07

10	5,7700E+00	2,5000E+00	4,4828E-02	6,2190E-04	4,4200E-02	6,5600E-06
11	6,3700E+00	2,5000E+00	3,8194E-02	9,2879E-05	3,8100E-02	9,6000E-07
12	6,6700E+00	2,5000E+00	4,7923E-02	1,1880E-05	4,7900E-02	1,1110E-05
13	7,1800E+00	2,5000E+00	3,5411E-02	7,7707E-06	3,5400E-02	2,7800E-06
14	7,4100E+00	2,5000E+00	3,9850E-02	1,4591E-04	3,9700E-02	4,3900E-06
15	8,3000E+00	2,5000E+00	3,7808E-02	1,0688E-04	3,7700E-02	9,7000E-07
16	8,9700E+00	2,5000E+00	3,8529E-02	1,2100E-04	3,8400E-02	8,3700E-06
17	9,3000E+00	2,5000E+00	4,2722E-02	5,2209E-04	4,2200E-02	2,8000E-07
18	1,0230E+01	2,5000E+00	3,8126E-02	2,4948E-05	3,8100E-02	1,3400E-06
19	1,0680E+01	2,5000E+00	3,6108E-02	5,0589E-04	3,5600E-02	1,8000E-06
20	1,0840E+01	2,5000E+00	4,5381E-02	8,8006E-04	4,4500E-02	6,1000E-07
21	1,1090E+01	2,5000E+00	4,3885E-02	8,8482E-04	4,3000E-02	3,2000E-07
22	1,2200E+01	2,5000E+00	4,9664E-02	6,2522E-05	4,9600E-02	1,0900E-06
23	1,2610E+01	2,5000E+00	4,2295E-02	7,9508E-04	4,1500E-02	1,7000E-07
24	1,3140E+01	2,5000E+00	4,1322E-02	1,9575E-05	4,1300E-02	2,2400E-06
25	1,5800E+01	2,5000E+00	4,1404E-02	1,0216E-04	4,1300E-02	1,9400E-06
26	1,6080E+01	2,5000E+00	4,9724E-02	9,2390E-04	4,8800E-02	4,9000E-07
27	1,6850E+01	2,5000E+00	3,4644E-02	2,4301E-04	3,4400E-02	1,5100E-06
28	1,7020E+01	2,5000E+00	4,1311E-02	5,7757E-06	4,1300E-02	4,9200E-06
29	1,7590E+01	2,5000E+00	3,9585E-02	1,8412E-04	3,9400E-02	1,3400E-06
30	1,7890E+01	2,5000E+00	4,1322E-02	1,8188E-05	4,1300E-02	3,8000E-06
31	1,8880E+01	2,5000E+00	4,1339E-02	3,6499E-05	4,1300E-02	2,8900E-06
32	1,9120E+01	2,5000E+00	4,8209E-02	1,0582E-04	4,8100E-02	2,9400E-06
33	1,9920E+01	2,5000E+00	3,5878E-02	7,4981E-05	3,5800E-02	2,9500E-06
34	2,0390E+01	2,5000E+00	4,1730E-02	1,1298E-03	4,0600E-02	4,1000E-07
35	2,1090E+01	2,5000E+00	3,5418E-02	5,1618E-04	3,4900E-02	1,4700E-06
36	2,1300E+01	2,5000E+00	4,1332E-02	2,3076E-05	4,1300E-02	8,5600E-06
37	2,2010E+01	2,5000E+00	4,1561E-02	1,2601E-03	4,0300E-02	7,4000E-07
38	2,2860E+01	2,5000E+00	4,0050E-02	4,4704E-04	3,9600E-02	3,2500E-06
39	2,3670E+01	2,5000E+00	4,1690E-02	1,6902E-03	4,0000E-02	1,9000E-07
40	2,3970E+01	2,5000E+00	6,0973E-02	1,7087E-04	6,0800E-02	2,6000E-06
41	2,4970E+01	2,5000E+00	4,8713E-02	4,6097E-03	4,4100E-02	3,2500E-06
42	2,6180E+01	2,5000E+00	4,0080E-02	2,3895E-04	3,9800E-02	4,1190E-05
43	2,6540E+01	2,5000E+00	4,4661E-02	2,8401E-03	4,1800E-02	2,1190E-05
44	2,7070E+01	2,5000E+00	4,1341E-02	2,4454E-05	4,1300E-02	1,6370E-05
45	2,8480E+01	2,5000E+00	4,1449E-02	1,4622E-04	4,1300E-02	2,4400E-06
46	2,8920E+01	2,5000E+00	4,1418E-02	1,0971E-04	4,1300E-02	8,3700E-06
47	2,9460E+01	2,5000E+00	4,1425E-02	8,5758E-05	4,1300E-02	3,8990E-05
48	3,0400E+01	2,5000E+00	4,2039E-02	3,7597E-03	3,8200E-02	7,9710E-05
49	3,0720E+01	2,5000E+00	5,3431E-02	3,2701E-04	5,3100E-02	4,1200E-06
50	3,1290E+01	2,5000E+00	3,6285E-02	2,7801E-04	3,6000E-02	6,8700E-06
51	3,1650E+01	2,5000E+00	4,1352E-02	4,7820E-05	4,1300E-02	3,8400E-06
52	3,3410E+01	2,5000E+00	2,8042E-02	4,3813E-04	2,7600E-02	4,3700E-06
53	3,3900E+01	2,5000E+00	6,5962E-02	4,5822E-04	6,5500E-02	4,1800E-06
54	3,4670E+01	2,5000E+00	4,1493E-02	1,8371E-04	4,1300E-02	9,0200E-06
55	3,5190E+01	2,5000E+00	3,7233E-02	3,2686E-04	3,6900E-02	5,7100E-06
56	3,6360E+01	2,5000E+00	6,8672E-02	1,5919E-04	6,8500E-02	1,2760E-05
57	3,6810E+01	2,5000E+00	4,1392E-02	7,2199E-05	4,1300E-02	2,0250E-05
58	3,7140E+01	2,5000E+00	4,6411E-02	1,3602E-03	4,4900E-02	1,5043E-04
59	3,7920E+01	2,5000E+00	4,1380E-02	6,4042E-05	4,1300E-02	1,5540E-05
60	3,8160E+01	2,5000E+00	6,3518E-02	1,6098E-03	6,1900E-02	8,4000E-06
61	3,8920E+01	2,5000E+00	5,7271E-02	1,2901E-03	5,5600E-02	3,8136E-04
62	3,9220E+01	2,5000E+00	4,7083E-02	6,5006E-04	4,6000E-02	4,3283E-04
63	3,9900E+01	2,5000E+00	7,8027E-02	6,6009E-04	7,3700E-02	3,6671E-03
64	4,1340E+01	2,5000E+00	3,9897E-02	2,2600E-03	3,7400E-02	2,3742E-04
65	4,2380E+01	2,5000E+00	4,1399E-02	9,0489E-05	4,1300E-02	8,6800E-06
66	4,2810E+01	2,5000E+00	4,1753E-02	1,1712E-04	4,1300E-02	3,3637E-04
67	4,3630E+01	2,5000E+00	4,1995E-02	2,8997E-04	4,1700E-02	5,2200E-06
68	4,5700E+01	2,5000E+00	6,2588E-02	4,8268E-04	6,2100E-02	5,5600E-06
69	4,6010E+01	2,5000E+00	4,2228E-02	6,5864E-04	4,1300E-02	2,6901E-04
70	4,6340E+01	2,5000E+00	4,6774E-02	3,0701E-03	4,3700E-02	3,6400E-06
71	4,7310E+01	2,5000E+00	4,5701E-02	2,3998E-03	4,3300E-02	9,4000E-07
72	4,8470E+01	2,5000E+00	4,1422E-02	1,1000E-04	4,1300E-02	1,2190E-05
73	4,8780E+01	2,5000E+00	4,1836E-02	5,3011E-04	4,1300E-02	5,9700E-06
74	4,9800E+01	2,5000E+00	4,6393E-02	5,0901E-03	4,1300E-02	2,4000E-06
75	5,0380E+01	2,5000E+00	4,8252E-02	8,9298E-03	3,9300E-02	2,1720E-05
76	5,1690E+01	2,5000E+00	4,1409E-02	9,1308E-05	4,1300E-02	1,7730E-05
77	5,2190E+01	2,5000E+00	4,1677E-02	3,7277E-04	4,1300E-02	4,6300E-06
78	5,2620E+01	2,5000E+00	4,2007E-02	7,0291E-04	4,1300E-02	4,3500E-06
79	5,3030E+01	2,5000E+00	4,1380E-02	6,1898E-05	4,1300E-02	1,8120E-05
80	5,3860E+01	2,5000E+00	4,1693E-02	3,8676E-04	4,1300E-02	6,1600E-06
81	5,4220E+01	2,5000E+00	4,1438E-02	1,3107E-04	4,1300E-02	6,9500E-06
82	5,5020E+01	2,5000E+00	4,1638E-02	3,1673E-04	4,1300E-02	2,1370E-05
83	5,6030E+01	2,5000E+00	1,0900E-01	1,9896E-03	1,0700E-01	6,5400E-06
84	5,8360E+01	2,5000E+00	4,1766E-02	4,6295E-04	4,1300E-02	2,6300E-06
85	5,8600E+01	2,5000E+00	4,1606E-02	2,9472E-04	4,1300E-02	1,1180E-05
86	5,9490E+01	2,5000E+00	4,5011E-02	2,0100E-03	4,3000E-02	1,2600E-06
87	6,0020E+01	2,5000E+00	4,5905E-02	2,6999E-03	4,3200E-02	5,0600E-06
88	6,0930E+01	2,5000E+00	4,0631E-02	1,8297E-03	3,8800E-02	1,2900E-06
89	6,1620E+01	2,5000E+00	4,1826E-02	5,2280E-04	4,1300E-02	3,0300E-06
90	6,2450E+01	2,5000E+00	8,2203E-02	2,0997E-03	8,0100E-02	3,0200E-06
91	6,2890E+01	2,5000E+00	4,7221E-02	1,7201E-03	4,5500E-02	1,2400E-06
92	6,3940E+01	2,5000E+00	4,1581E-02	2,7587E-04	4,1300E-02	5,4400E-06
93	6,4940E+01	2,5000E+00	4,4712E-02	1,0097E-03	4,3700E-02	2,2900E-06
94	6,5680E+01	2,5000E+00	5,0552E-02	4,5498E-03	4,6000E-02	2,5100E-06
95	6,7460E+01	2,5000E+00	4,3982E-02	5,7798E-03	3,8200E-02	1,9100E-06
96	6,7940E+01	2,5000E+00	4,5992E-02	2,3903E-03	4,3600E-02	1,3000E-06
97	6,8750E+01	2,5000E+00	4,1662E-02	3,5902E-04	4,1300E-02	3,3200E-06
98	7,0230E+01	2,5000E+00	6,8044E-02	2,1403E-03	6,5900E-02	3,7400E-06
99	7,0660E+01	2,5000E+00	4,1805E-02	5,0015E-04	4,1300E-02	4,4300E-06
100	7,1180E+01	2,5000E+00	4,3601E-02	2,2999E-03	4,1300E-02	1,3400E-06
101	7,1440E+01	2,5000E+00	4,3981E-02	2,6802E-03	4,1300E-02	7,4000E-07
102	7,3860E+01	2,5000E+00	4,1613E-02	3,1025E-04	4,1300E-02	2,7900E-06
103	7,4260E+01	2,5000E+00	4,2772E-02	1,4701E-03	4,1300E-02	1,8100E-06
104	7,4540E+01	2,5000E+00	4,1818E-02	5,1025E-04	4,1300E-02	8,2300E-06

105	7,5090E+01	2,5000E+00	4,1476E-02	1,1005E-04	4,1300E-02	6,6090E-05
106	7,6530E+01	2,5000E+00	4,1489E-02	1,8634E-04	4,1300E-02	2,2200E-06
107	7,6970E+01	2,5000E+00	4,1676E-02	3,7462E-04	4,1300E-02	1,8600E-06
108	7,8330E+01	2,5000E+00	7,8751E-02	2,4498E-03	7,6300E-02	1,4100E-06
109	7,9240E+01	2,5000E+00	5,4120E-02	2,5201E-03	5,1600E-02	2,1000E-07
110	8,0350E+01	2,5000E+00	4,1466E-02	1,5687E-04	4,1300E-02	9,2700E-06
111	8,0600E+01	2,5000E+00	4,1845E-02	5,4226E-04	4,1300E-02	2,6200E-06
112	8,1590E+01	2,5000E+00	4,1723E-02	4,2002E-04	4,1300E-02	2,6000E-06
113	8,2090E+01	2,5000E+00	4,2119E-02	8,1815E-04	4,1300E-02	1,2300E-06
114	8,3390E+01	2,5000E+00	4,4412E-02	3,1103E-03	4,1300E-02	1,2700E-06
115	8,3700E+01	2,5000E+00	4,6851E-02	5,5496E-03	4,1300E-02	1,1300E-06
116	8,5190E+01	2,5000E+00	6,4073E-02	1,1703E-03	6,2900E-02	3,1600E-06
117	8,6070E+01	2,5000E+00	4,2140E-02	8,3496E-04	4,1300E-02	5,3100E-06
118	8,6500E+01	2,5000E+00	4,9022E-02	5,7198E-03	4,3300E-02	2,5500E-06
119	8,7650E+01	2,5000E+00	4,5000E-02	3,6999E-03	4,1300E-02	3,2000E-07
120	8,8130E+01	2,5000E+00	4,2335E-02	1,0298E-03	4,1300E-02	4,7300E-06
121	8,8900E+01	2,5000E+00	4,3151E-02	1,8499E-03	4,1300E-02	1,3600E-06
122	8,9430E+01	2,5000E+00	5,1293E-02	4,2896E-03	4,7000E-02	3,8200E-06
123	9,0840E+01	2,5000E+00	5,4883E-02	4,9799E-03	4,9900E-02	3,2900E-06
124	9,1320E+01	2,5000E+00	4,1466E-02	1,5768E-04	4,1300E-02	8,6200E-06
125	9,1950E+01	2,5000E+00	4,1819E-02	5,1014E-04	4,1300E-02	8,7900E-06
126	9,2750E+01	2,5000E+00	4,1498E-02	1,8876E-04	4,1300E-02	9,1600E-06
127	9,3360E+01	2,5000E+00	4,8803E-02	1,8001E-03	4,7000E-02	3,2400E-06
128	9,4220E+01	2,5000E+00	4,1668E-02	3,6788E-04	4,1300E-02	5,0000E-07
129	9,5370E+01	2,5000E+00	4,1665E-02	3,5840E-04	4,1300E-02	6,5400E-06
130	9,6140E+01	2,5000E+00	4,1368E-02	5,4909E-05	4,1300E-02	1,3460E-05
131	9,6610E+01	2,5000E+00	4,1661E-02	3,4991E-04	4,1300E-02	1,1480E-05
132	9,7720E+01	2,5000E+00	6,5281E-02	3,4796E-03	6,1800E-02	1,5400E-06
133	9,8460E+01	2,5000E+00	7,7381E-02	2,3795E-03	7,5000E-02	1,4200E-06
134	9,8990E+01	2,5000E+00	4,1417E-02	9,9494E-05	4,1300E-02	1,7290E-05
135	9,9490E+01	2,5000E+00	5,1743E-02	1,9400E-03	4,9800E-02	2,6200E-06
136	1,0019E+02	2,5000E+00	5,8401E-02	5,3000E-03	5,3100E-02	1,2400E-06
137	1,0103E+02	2,5000E+00	6,2512E-02	5,4096E-03	5,7100E-02	2,3000E-06
138	1,0162E+02	2,5000E+00	4,2533E-02	1,2298E-03	4,1300E-02	3,0100E-06
139	1,0192E+02	2,5000E+00	4,2971E-02	1,6698E-03	4,1300E-02	1,3800E-06
140	1,0215E+02	2,5000E+00	4,1605E-02	3,0018E-04	4,1300E-02	5,1100E-06
141	1,0376E+02	2,5000E+00	4,2902E-02	1,5982E-03	4,1300E-02	3,8100E-06
142	1,0452E+02	2,5000E+00	4,1645E-02	3,3942E-04	4,1300E-02	6,0700E-06
143	1,0510E+02	2,5000E+00	7,9688E-02	2,1783E-03	7,7500E-02	9,6000E-06
144	1,0570E+02	2,5000E+00	4,4400E-02	3,2868E-03	4,1100E-02	1,3540E-05
145	1,0702E+02	2,5000E+00	4,1823E-02	5,1311E-04	4,1300E-02	1,0200E-05
146	1,0879E+02	2,5000E+00	4,2119E-02	8,1356E-04	4,1300E-02	5,0600E-06
147	1,0912E+02	2,5000E+00	4,3591E-02	2,2898E-03	4,1300E-02	9,4000E-07
148	1,1030E+02	2,5000E+00	4,2512E-02	1,2099E-03	4,1300E-02	1,8100E-06
149	1,1050E+02	2,5000E+00	4,2392E-02	1,0894E-03	4,1300E-02	2,2300E-06
150	1,1096E+02	2,5000E+00	4,4371E-02	3,0695E-03	4,1300E-02	1,3000E-06
151	1,1171E+02	2,5000E+00	4,4572E-02	3,2701E-03	4,1300E-02	1,5100E-06
152	1,1222E+02	2,5000E+00	4,1717E-02	3,9831E-04	4,1300E-02	1,8620E-05
153	1,1333E+02	2,5000E+00	4,2519E-02	1,2104E-03	4,1300E-02	8,8900E-06
154	1,1371E+02	2,5000E+00	4,5604E-02	4,2995E-03	4,1300E-02	4,4400E-06
155	1,1473E+02	2,5000E+00	4,3511E-02	2,2097E-03	4,1300E-02	1,7600E-06
156	1,1546E+02	2,5000E+00	4,1811E-02	4,9750E-04	4,1300E-02	1,3750E-05
157	1,1579E+02	2,5000E+00	4,3402E-02	2,0757E-03	4,1300E-02	2,5870E-05
158	1,1676E+02	2,5000E+00	4,1772E-02	4,3979E-04	4,1300E-02	3,2070E-05
159	1,1762E+02	2,5000E+00	4,3369E-02	2,0205E-03	4,1300E-02	4,8880E-05
160	1,1907E+02	2,5000E+00	4,3724E-02	1,2396E-03	4,1300E-02	1,1843E-03
161	1,1946E+02	2,5000E+00	4,3459E-02	7,4978E-04	4,1300E-02	1,4090E-03
162	1,2010E+02	2,5000E+00	4,1776E-02	3,2548E-04	4,1300E-02	1,5091E-04
163	1,2196E+02	2,5000E+00	4,1722E-02	3,5008E-04	4,1300E-02	7,1790E-05
164	1,2376E+02	2,5000E+00	4,1769E-02	4,0383E-04	4,1300E-02	6,5080E-05
165	1,2501E+02	2,5000E+00	4,2540E-02	1,2098E-03	4,1300E-02	3,0120E-05
166	1,2569E+02	2,5000E+00	4,4015E-02	2,7096E-03	4,1300E-02	5,7200E-06
167	1,2620E+02	2,5000E+00	4,3050E-02	1,7401E-03	4,1300E-02	9,6100E-06
168	1,2712E+02	2,5000E+00	4,1829E-02	5,0060E-04	4,1300E-02	2,8130E-05
169	1,2750E+02	2,5000E+00	4,1715E-02	4,0763E-04	4,1300E-02	7,7500E-06
170	1,2948E+02	2,5000E+00	4,2281E-02	9,6948E-04	4,1300E-02	1,1980E-05

NEPTUNIUM-237

ENDF/B MATERIAL NO. 6263
RESONANCE DATA
RESONANCE PARAMETERS

ISOTOPE-------------------------NEPTUNIUM-237
FRACTIONAL ABUNDANCE---------- 1.0000E+00
NUMBER OF ENERGY RANGES------- 2

ENERGY RANGE NUMBER----------- 2
LOWER ENERGY LIMIT (EV)------- 1.3000E+02
UPPER ENERGY LIMIT (EV)------- 4.0000E+04
NUCLEAR SPIN------------------ 2.5000E+00
EFFECTIVE SCATTERING RADIUS--- 9.1410E-01
NUMBER OF L STATES------------ 2

UNRESOLVED SINGLE-LEVEL BREIT-WIGNER PARAMETERS

L VALUE----------------------- 0
NUMBER OF J STATES------------ 2

DEGREES OF FREEDOM USED IN THE WIDTH DISTRIBUTION

J-VALUE	COMPETITIVE	NEUTRON	RADIATION	FISSION
2.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	1.0000E+00

AVERAGE RESONANCE WIDTHS (EV)

INDEX	ENERGY (EV)	LEVEL SPACING	COMPETITIVE	NEUTRON	RADIATION	FISSION
1	1.3000E+02	1.0000E+00	0.0000E+00	1.1064E-04	4.0000E-02	5.4391E-06
2	1.9800E+02	1.0000E+00	0.0000E+00	1.1157E-04	4.0000E-02	3.0718E-04
3	2.0800E+02	1.0000E+00	0.0000E+00	1.1075E-04	4.0000E-02	2.8031E-06
4	2.3100E+02	1.0000E+00	0.0000E+00	1.1102E-04	4.0000E-02	9.1923E-05
5	2.4000E+02	1.0000E+00	0.0000E+00	1.1082E-04	4.0000E-02	1.3643E-05
6	2.4900E+02	1.0000E+00	0.0000E+00	1.1114E-04	4.0000E-02	1.2935E-04
7	2.5900E+02	1.0000E+00	0.0000E+00	1.1080E-04	4.0000E-02	3.1592E-06
8	2.7800E+02	1.0000E+00	0.0000E+00	1.1112E-04	4.0000E-02	1.1138E-04
9	2.8800E+02	1.0000E+00	0.0000E+00	1.1083E-04	4.0000E-02	3.3436E-06
10	3.3000E+02	1.0000E+00	0.0000E+00	1.1112E-04	4.0000E-02	9.9855E-05
11	3.4000E+02	1.0000E+00	0.0000E+00	1.1086E-04	4.0000E-02	3.6693E-06
12	3.6700E+02	1.0000E+00	0.0000E+00	1.1147E-04	4.0000E-02	2.2074E-04
13	3.7700E+02	1.0000E+00	0.0000E+00	1.1088E-04	4.0000E-02	3.8833E-06
14	4.1900E+02	1.0000E+00	0.0000E+00	1.1141E-04	4.0000E-02	1.9021E-04
15	4.2900E+02	1.0000E+00	0.0000E+00	1.1090E-04	4.0000E-02	4.1746E-06
16	4.6800E+02	1.0000E+00	0.0000E+00	1.1124E-04	4.0000E-02	1.2090E-04
17	4.7800E+02	1.0000E+00	0.0000E+00	1.1091E-04	4.0000E-02	4.4344E-06
18	5.4100E+02	1.0000E+00	0.0000E+00	1.1105E-04	4.0000E-02	4.9284E-05
19	5.5100E+02	1.0000E+00	0.0000E+00	1.1093E-04	4.0000E-02	4.8023E-06
20	5.7100E+02	1.0000E+00	0.0000E+00	1.1117E-04	4.0000E-02	8.9990E-05
21	5.8100E+02	1.0000E+00	0.0000E+00	1.1094E-04	4.0000E-02	4.9479E-06
22	6.5300E+02	1.0000E+00	0.0000E+00	1.1162E-04	4.0000E-02	2.5470E-04
23	6.6300E+02	1.0000E+00	0.0000E+00	1.1094E-04	4.0000E-02	5.3310E-06
24	7.0200E+02	1.0000E+00	0.0000E+00	1.1132E-04	4.0000E-02	1.4373E-04
25	7.1200E+02	1.0000E+00	0.0000E+00	1.1094E-04	4.0000E-02	5.5511E-06
26	7.8700E+02	1.0000E+00	0.0000E+00	1.1150E-04	4.0000E-02	2.1128E-04
27	7.9700E+02	1.0000E+00	0.0000E+00	1.1093E-04	4.0000E-02	5.9191E-06
28	8.5900E+02	1.0000E+00	0.0000E+00	1.1177E-04	4.0000E-02	3.1373E-04
29	8.6900E+02	1.0000E+00	0.0000E+00	1.1092E-04	4.0000E-02	6.2191E-06
30	9.4100E+02	1.0000E+00	0.0000E+00	1.1093E-04	4.0000E-02	1.0742E-05
31	9.5100E+02	1.0000E+00	0.0000E+00	1.1091E-04	4.0000E-02	6.5490E-06
32	1.0060E+03	1.0000E+00	0.0000E+00	1.1158E-04	4.0000E-02	2.5609E-04
33	1.0150E+03	1.0000E+00	0.0000E+00	1.1092E-04	4.0000E-02	1.7004E-05
34	1.0220E+03	1.0000E+00	0.0000E+00	1.1100E-04	4.0000E-02	4.4391E-05
35	1.0320E+03	1.0000E+00	0.0000E+00	1.1090E-04	4.0000E-02	6.8636E-06
36	1.0850E+03	1.0000E+00	0.0000E+00	1.1120E-04	4.0000E-02	1.2102E-04
37	1.0920E+03	1.0000E+00	0.0000E+00	1.1096E-04	4.0000E-02	3.5497E-05
38	1.1210E+03	1.0000E+00	0.0000E+00	1.1182E-04	4.0000E-02	3.5439E-04
39	1.1310E+03	1.0000E+00	0.0000E+00	1.1087E-04	4.0000E-02	7.2361E-06
40	1.1990E+03	1.0000E+00	0.0000E+00	1.1106E-04	4.0000E-02	8.1452E-05
[illegible]	1.2090E+03	1.0000E+00	0.0000E+00	1.1084E-04	4.0000E-02	7.5211E-06
42	1.2300E+03	1.0000E+00	0.0000E+00	1.1165E-04	4.0000E-02	3.0127E-04
43	1.2400E+03	1.0000E+00	0.0000E+00	1.1083E-04	4.0000E-02	7.6323E-06
44	1.2730E+03	1.0000E+00	0.0000E+00	1.1176E-04	4.0000E-02	3.5073E-04
45	1.2830E+03	1.0000E+00	0.0000E+00	1.1082E-04	4.0000E-02	7.7846E-06
46	1.3130E+03	1.0000E+00	0.0000E+00	1.1092E-04	4.0000E-02	5.0586E-05
47	1.3230E+03	1.0000E+00	0.0000E+00	1.1081E-04	4.0000E-02	7.9241E-06
48	1.3760E+03	1.0000E+00	0.0000E+00	1.1137E-04	4.0000E-02	2.2033E-04
49	1.3860E+03	1.0000E+00	0.0000E+00	1.1078E-04	4.0000E-02	8.1419E-06
50	1.4290E+03	1.0000E+00	0.0000E+00	1.0967E-04	4.0000E-02	7.6345E-05
51	1.4390E+03	1.0000E+00	0.0000E+00	1.1077E-04	4.0000E-02	8.3214E-06
52	1.4600E+03	1.0000E+00	0.0000E+00	1.1087E-04	4.0000E-02	4.8745E-05
53	1.4700E+03	1.0000E+00	0.0000E+00	1.1075E-04	4.0000E-02	8.4257E-06

54	1,4990E+03	1.0000E+00	0,0000E+00	1,1081E-04	4.0000E-02	3,3268E-05
55	1,5090E+03	1.0000E+00	0,0000E+00	1,1075E-04	4.0000E-02	8,5545E-06
56	1,5470E+03	1.0000E+00	0,0000E+00	1,1088E-04	4.0000E-02	6,3502E-05
57	1,5570E+03	1.0000E+00	0,0000E+00	1,1072E-04	4.0000E-02	8,7129E-06
58	1,5780E+03	1.0000E+00	0,0000E+00	1,1096E-04	4.0000E-02	9,6928E-05
59	1,5880E+03	1.0000E+00	0.0000E+00	1,1071E-04	4.0000E-02	8,8137E-06
60	1,6220E+03	1.0000E+00	0,0000E+00	1,1071E-04	4.0000E-02	1,7654E-05
61	1,6320E+03	1.0000E+00	0,0000E+00	1,1069E-04	4.0000E-02	8,9557E-06
62	1,6740E+03	1.0000E+00	0,0000E+00	1,1093E-04	4.0000E-02	1,0448E-04
63	1,6840E+03	1.0000E+00	0,0000E+00	1,1067E-04	4.0000E-02	9,1212E-06
64	1,7040E+03	1.0000E+00	0,0000E+00	1,1117E-04	4.0000E-02	1,9614E-04
65	1,7140E+03	1.0000E+00	0,0000E+00	1,1066E-04	4.0000E-02	9,2157E-06
66	1,7340E+03	1.0000E+00	0,0000E+00	1,1089E-04	4.0000E-02	9,7769E-05
67	1,7440E+03	1.0000E+00	0,0000E+00	1,1065E-04	4.0000E-02	9,3101E-06
68	1,8700E+03	1.0000E+00	0,0000E+00	1,1258E-04	4.0000E-02	7,5674E-04
69	1,8800E+03	1.0000E+00	0,0000E+00	1,1059E-04	4.0000E-02	9,7290E-06
70	1,8960E+03	1.0000E+00	0,0000E+00	1,1082E-04	4.0000E-02	9,8610E-05
71	1,9060E+03	1.0000E+00	0,0000E+00	1,1058E-04	4.0000E-02	9,8077E-06
72	1,9240E+03	1.0000E+00	0,0000E+00	1,1077E-04	4.0000E-02	8,4718E-05
73	1,9340E+03	1.0000E+00	0,0000E+00	1,1056E-04	4.0000E-02	9,8926E-06
74	1,9970E+03	1.0000E+00	0,0000E+00	1,1069E-04	4.0000E-02	7,0734E-05
75	2,0070E+03	1.0000E+00	0.0000E+00	1,1053E-04	4.0000E-02	1,0110E-05
76	2,0390E+03	1.0000E+00	0.0000E+00	1,1059E-04	4.0000E-02	3.8308E-05
77	2,1010E+03	1.0000E+00	0,0000E+00	1,1047E-04	4.0000E-02	6.7502E-06
78	2,1280E+03	1.0000E+00	0,0000E+00	1,1048E-04	4.0000E-02	1.7795E-05
79	2,1560E+03	1.0000E+00	0,0000E+00	1,1043E-04	4.0000E-02	3,6900E-06
80	2,1750E+03	1.0000E+00	0,0000E+00	1,1044E-04	4.0000E-02	1,0630E-05
81	2,1850E+03	1.0000E+00	0,0000E+00	1,1042E-04	4.0000E-02	4,7820E-06
82	2,2140E+03	1.0000E+00	0,0000E+00	1,1049E-04	4.0000E-02	3,5384E-05
83	2,2240E+03	1.0000E+00	0,0000E+00	1,1046E-04	4.0000E-02	2,3640E-05
84	2,2540E+03	1.0000E+00	0,0000E+00	1,1064E-04	4.0000E-02	9.8359E-05
85	2,2840E+03	1.0000E+00	0,0000E+00	1,1036E-04	4.0000E-02	1,0906E-06
86	2,3050E+03	1.0000E+00	0,0000E+00	1,1039E-04	4.0000E-02	1,9203E-05
87	2,3150E+03	1.0000E+00	0,0000E+00	1,1036E-04	4.0000E-02	5,4972E-06
88	2,3360E+03	1.0000E+00	0,0000E+00	1,1033E-04	4.0000E-02	1,1052E-06
89	2,3580E+03	1.0000E+00	0,0000E+00	1,1032E-04	4.0000E-02	3,3342E-06
90	2,3790E+03	1.0000E+00	0.0000E+00	1,1036E-04	4.0000E-02	2,4041E-05
91	2,4010E+03	1.0000E+00	0,0000E+00	1,1030E-04	4.0000E-02	2,2464E-06
92	2,4230E+03	1.0000E+00	0,0000E+00	1,1051E-04	4.0000E-02	8,7873E-05
93	2,4460E+03	1.0000E+00	0,0000E+00	1,1030E-04	4.0000E-02	1,3066E-05
94	2,4800E+03	1.0000E+00	0,0000E+00	1,1027E-04	4.0000E-02	6,2980E-06
95	2,5160E+03	1.0000E+00	0,0000E+00	1,1047E-04	4.0000E-02	8,3442E-05
96	2,5390E+03	1.0000E+00	0,0000E+00	1,1026E-04	4.0000E-02	1,8588E-05
97	2,5640E+03	1.0000E+00	0,0000E+00	1,1057E-04	4.0000E-02	1,3196E-04
98	2,6130E+03	1.0000E+00	0,0000E+00	1,1019E-04	4.0000E-02	7,6775E-06
99	2,6640E+03	1.0000E+00	0,0000E+00	1,1020E-04	4.0000E-02	1,6132E-05
100	2,7300E+03	1.0000E+00	0,0000E+00	1,1054E-04	4.0000E-02	1.5971E-04
101	2,7570E+03	1.0000E+00	0,0000E+00	1,1018E-04	4.0000E-02	3,2338E-05
102	2,7710E+03	1.0000E+00	0,0000E+00	1,1022E-04	4.0000E-02	5,0219E-05
103	2,8120E+03	1.0000E+00	0,0000E+00	1,1083E-04	4.0000E-02	7,9759E-06
104	2,8400E+03	1.0000E+00	0,0000E+00	1,1094E-04	4.0000E-02	4,7573E-05
105	2,8690E+03	1.0000E+00	0,0000E+00	1,1084E-04	4.0000E-02	1,6145E-05
106	2,8980E+03	1.0000E+00	0,0000E+00	1,1104E-04	4.0000E-02	8,8947E-05
107	2,9580E+03	1.0000E+00	0,0000E+00	1,1081E-04	4.0000E-02	1,2010E-05
108	3,0190E+03	1.0000E+00	0,0000E+00	1,1144E-04	4.0000E-02	2,5043E-04
109	3,0660E+03	1.0000E+00	0,0000E+00	1,1078E-04	4.0000E-02	1,2265E-05
110	3,1310E+03	1.0000E+00	0,0000E+00	1,1116E-04	4.0000E-02	1,5903E-04
111	3,1640E+03	1.0000E+00	0,0000E+00	1,1081E-04	4.0000E-02	3,4221E-05
112	3,1980E+03	1.0000E+00	0,0000E+00	1,1110E-04	4.0000E-02	1,4363E-04
113	3,2320E+03	1.0000E+00	0,0000E+00	1,1081E-04	4.0000E-02	4,2660E-05
114	3,2490E+03	1.0000E+00	0,0000E+00	1,1100E-04	4.0000E-02	1,1060E-04
115	3,3020E+03	1.0000E+00	0,0000E+00	1,1072E-04	4.0000E-02	1,4834E-05
116	3,3560E+03	1.0000E+00	0,0000E+00	1,1108E-04	4.0000E-02	1,5396E-04
117	3,3930E+03	1.0000E+00	0,0000E+00	1,1072E-04	4.0000E-02	2,4672E-05
118	3,4500E+03	1.0000E+00	0,0000E+00	1,1098E-04	4.0000E-02	1,2713E-04
119	3,4880E+03	1.0000E+00	0,0000E+00	1,1071E-04	4.0000E-02	3,2746E-05
120	3,5470E+03	1.0000E+00	0,0000E+00	1,1065E-04	4.0000E-02	1,6876E-05
121	3,6070E+03	1.0000E+00	0,0000E+00	1,1074E-04	4.0000E-02	5,5495E-05
122	3,6900E+03	1.0000E+00	0,0000E+00	1,1062E-04	4.0000E-02	2,3034E-05
123	3,7540E+03	1.0000E+00	0,0000E+00	1,1096E-04	4.0000E-02	1,5278E-04
124	3,8640E+03	1.0000E+00	0,0000E+00	1,1053E-04	4.0000E-02	8,1295E-06
125	3,9100E+03	1.0000E+00	0,0000E+00	1,1078E-04	4.0000E-02	1,0531E-04
126	4,0270E+03	1.0000E+00	0,0000E+00	1,1052E-04	4.0000E-02	2.2725E-05
127	4,0760E+03	1.0000E+00	0,0000E+00	1,1062E-04	4.0000E-02	6.4997E-05
128	4,3310E+03	1.0000E+00	0,0000E+00	1,1049E-04	4.0000E-02	4,6662E-05
129	4,3860E+03	1.0000E+00	0,0000E+00	1,1056E-04	4.0000E-02	7.9053E-05
130	4,4970E+03	1.0000E+00	0,0000E+00	1,1037E-04	4.0000E-02	2,1004E-05
131	4,6720E+03	1.0000E+00	0,0000E+00	1,1044E-04	4.0000E-02	2,1266E-04
132	4,7940E+03	1.0000E+00	0,0000E+00	1,0993E-04	4.0000E-02	2,5195E-05
133	4,9540E+03	1.0000E+00	0,0000E+00	1,1014E-04	4.0000E-02	1,0211E-04
134	4,0000E+04	1.0000E+00	0,0000E+00	1,1062E-04	4.0000E-02	2,7916E-04

	J-VALUE	COMPETITIVE	NEUTRON	RADIATION	FISSION
DEGREES OF FREEDOM USED IN THE WIDTH DISTRIBUTION	3.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	1.0000E+00

AVERAGE RESONANCE WIDTHS (EV)

INDEX	ENERGY (EV)	LEVEL SPACING	COMPETITIVE	NEUTRON	RADIATION	FISSION
1	1.3000E+02	1.0000E+00	0.0000E+00	1.1064E-04	4.0000E-02	5.4391E-06
2	1.9800E+02	1.0000E+00	0.0000E+00	1.1157E-04	4.0000E-02	3.0718E-04
3	2.0800E+02	1.0000E+00	0.0000E+00	1.1075E-04	4.0000E-02	2.8031E-06
4	2.3100E+02	1.0000E+00	0.0000E+00	1.1102E-04	4.0000E-02	9.1923E-05
5	2.4000E+02	1.0000E+00	0.0000E+00	1.1082E-04	4.0000E-02	1.3643E-05
6	2.4900E+02	1.0000E+00	0.0000E+00	1.1114E-04	4.0000E-02	1.2935E-04
7	2.5900E+02	1.0000E+00	0.0000E+00	1.1080E-04	4.0000E-02	3.1592E-06
8	2.7800E+02	1.0000E+00	0.0000E+00	1.1112E-04	4.0000E-02	1.1138E-04
9	2.8800E+02	1.0000E+00	0.0000E+00	1.1083E-04	4.0000E-02	3.3486E-06
10	3.3000E+02	1.0000E+00	0.0000E+00	1.1112E-04	4.0000E-02	9.9855E-05
11	3.4000E+02	1.0000E+00	0.0000E+00	1.1086E-04	4.0000E-02	3.6693E-06
12	3.6700E+02	1.0000E+00	0.0000E+00	1.1147E-04	4.0000E-02	2.2074E-04
13	3.7700E+02	1.0000E+00	0.0000E+00	1.1088E-04	4.0000E-02	3.8853E-06
14	4.1900E+02	1.0000E+00	0.0000E+00	1.1141E-04	4.0000E-02	1.9021E-04
15	4.2900E+02	1.0000E+00	0.0000E+00	1.1090E-04	4.0000E-02	4.1746E-06
16	4.6800E+02	1.0000E+00	0.0000E+00	1.1124E-04	4.0000E-02	1.2090E-04
17	4.7800E+02	1.0000E+00	0.0000E+00	1.1091E-04	4.0000E-02	4.4344E-06
18	5.4100E+02	1.0000E+00	0.0000E+00	1.1105E-04	4.0000E-02	4.9284E-05
19	5.5100E+02	1.0000E+00	0.0000E+00	1.1093E-04	4.0000E-02	4.8023E-06
20	5.7100E+02	1.0000E+00	0.0000E+00	1.1117E-04	4.0000E-02	8.9990E-05
21	5.8100E+02	1.0000E+00	0.0000E+00	1.1094E-04	4.0000E-02	4.9479E-06
22	6.5300E+02	1.0000E+00	0.0000E+00	1.1162E-04	4.0000E-02	2.5470E-04
23	6.6300E+02	1.0000E+00	0.0000E+00	1.1094E-04	4.0000E-02	5.3310E-06
24	7.0200E+02	1.0000E+00	0.0000E+00	1.1132E-04	4.0000E-02	1.4373E-04
25	7.1200E+02	1.0000E+00	0.0000E+00	1.1094E-04	4.0000E-02	5.5511E-06
26	7.8700E+02	1.0000E+00	0.0000E+00	1.1150E-04	4.0000E-02	2.1128E-04
27	7.9700E+02	1.0000E+00	0.0000E+00	1.1093E-04	4.0000E-02	5.9191E-06
28	8.5900E+02	1.0000E+00	0.0000E+00	1.1177E-04	4.0000E-02	3.1373E-04
29	8.6900E+02	1.0000E+00	0.0000E+00	1.1092E-04	4.0000E-02	6.2191E-06
30	9.4100E+02	1.0000E+00	0.0000E+00	1.1093E-04	4.0000E-02	1.0742E-05
31	9.5100E+02	1.0000E+00	0.0000E+00	1.1091E-04	4.0000E-02	6.5490E-06
32	1.0060E+03	1.0000E+00	0.0000E+00	1.1158E-04	4.0000E-02	2.5609E-04
33	1.0150E+03	1.0000E+00	0.0000E+00	1.1092E-04	4.0000E-02	1.7004E-05
34	1.0220E+03	1.0000E+00	0.0000E+00	1.1100E-04	4.0000E-02	4.4391E-05
35	1.0320E+03	1.0000E+00	0.0000E+00	1.1090E-04	4.0000E-02	6.8636E-06
36	1.0850E+03	1.0000E+00	0.0000E+00	1.1120E-04	4.0000E-02	1.2102E-04
37	1.0920E+03	1.0000E+00	0.0000E+00	1.1096E-04	4.0000E-02	3.5497E-05
38	1.1210E+03	1.0000E+00	0.0000E+00	1.1182E-04	4.0000E-02	3.5439E-04
39	1.1310E+03	1.0000E+00	0.0000E+00	1.1087E-04	4.0000E-02	7.2361E-06
40	1.1990E+03	1.0000E+00	0.0000E+00	1.1106E-04	4.0000E-02	8.1452E-05
41	1.2090E+03	1.0000E+00	0.0000E+00	1.1084E-04	4.0000E-02	7.5211E-06
42	1.2300E+03	1.0000E+00	0.0000E+00	1.1165E-04	4.0000E-02	3.0127E-04
43	1.2400E+03	1.0000E+00	0.0000E+00	1.1083E-04	4.0000E-02	7.6323E-06
44	1.2730E+03	1.0000E+00	0.0000E+00	1.1176E-04	4.0000E-02	3.5073E-04
45	1.2830E+03	1.0000E+00	0.0000E+00	1.1082E-04	4.0000E-02	7.7846E-06
46	1.3130E+03	1.0000E+00	0.0000E+00	1.1092E-04	4.0000E-02	5.0586E-05
47	1.3230E+03	1.0000E+00	0.0000E+00	1.1081E-04	4.0000E-02	7.9241E-06
48	1.3760E+03	1.0000E+00	0.0000E+00	1.1137E-04	4.0000E-02	2.2033E-04
49	1.3860E+03	1.0000E+00	0.0000E+00	1.1078E-04	4.0000E-02	8.1419E-06
50	1.4290E+03	1.0000E+00	0.0000E+00	1.0967E-04	4.0000E-02	7.6345E-05
51	1.4390E+03	1.0000E+00	0.0000E+00	1.1077E-04	4.0000E-02	8.3214E-06
52	1.4600E+03	1.0000E+00	0.0000E+00	1.1087E-04	4.0000E-02	4.8745E-05
53	1.4700E+03	1.0000E+00	0.0000E+00	1.1075E-04	4.0000E-02	8.4257E-06
54	1.4990E+03	1.0000E+00	0.0000E+00	1.1081E-04	4.0000E-02	3.3268E-05
55	1.5090E+03	1.0000E+00	0.0000E+00	1.1075E-04	4.0000E-02	8.5545E-06
56	1.5470E+03	1.0000E+00	0.0000E+00	1.1088E-04	4.0000E-02	6.3502E-05
57	1.5570E+03	1.0000E+00	0.0000E+00	1.1072E-04	4.0000E-02	8.7129E-06
58	1.5780E+03	1.0000E+00	0.0000E+00	1.1096E-04	4.0000E-02	9.6928E-05
59	1.5880E+03	1.0000E+00	0.0000E+00	1.1071E-04	4.0000E-02	8.8137E-06
60	1.6220E+03	1.0000E+00	0.0000E+00	1.1071E-04	4.0000E-02	1.7854E-05
61	1.6320E+03	1.0000E+00	0.0000E+00	1.1069E-04	4.0000E-02	8.9557E-06
62	1.6740E+03	1.0000E+00	0.0000E+00	1.1093E-04	4.0000E-02	1.0448E-04
63	1.6840E+03	1.0000E+00	0.0000E+00	1.1067E-04	4.0000E-02	9.1212E-06
64	1.7040E+03	1.0000E+00	0.0000E+00	1.1117E-04	4.0000E-02	1.9614E-04
65	1.7140E+03	1.0000E+00	0.0000E+00	1.1066E-04	4.0000E-02	9.2157E-06
66	1.7340E+03	1.0000E+00	0.0000E+00	1.1089E-04	4.0000E-02	9.7769E-05

67	1.7440E+03	1.0000E+00	0.0000E+00	1.1065E-04	4.0000E-02	9.3101E-06
68	1.8700E+03	1.0000E+00	0.0000E+00	1.1258E-04	4.0000E-02	7.5674E-04
69	1.8800E+03	1.0000E+00	0.0000E+00	1.1059E-04	4.0000E-02	9.7290E-06
70	1.8960E+03	1.0000E+00	0.0000E+00	1.1082E-04	4.0000E-02	9.8610E-05
71	1.9060E+03	1.0000E+00	0.0000E+00	1.1058E-04	4.0000E-02	9.8077E-06
72	1.9240E+03	1.0000E+00	0.0000E+00	1.1077E-04	4.0000E-02	8.4718E-05
73	1.9340E+03	1.0000E+00	0.0000E+00	1.1056E-04	4.0000E-02	9.8926E-06
74	1.9970E+03	1.0000E+00	0.0000E+00	1.1069E-04	4.0000E-02	7.0734E-05
75	2.0070E+03	1.0000E+00	0.0000E+00	1.1053E-04	4.0000E-02	1.0110E-05
76	2.0390E+03	1.0000E+00	0.0000E+00	1.1059E-04	4.0000E-02	3.8308E-05
77	2.1010E+03	1.0000E+00	0.0000E+00	1.1047E-04	4.0000E-02	6.7582E-06
78	2.1280E+03	1.0000E+00	0.0000E+00	1.1048E-04	4.0000E-02	1.7795E-05
79	2.1560E+03	1.0000E+00	0.0000E+00	1.1043E-04	4.0000E-02	3.6900E-06
80	2.1750E+03	1.0000E+00	0.0000E+00	1.1044E-04	4.0000E-02	1.0630E-05
81	2.1850E+03	1.0000E+00	0.0000E+00	1.1042E-04	4.0000E-02	4.7820E-06
82	2.2140E+03	1.0000E+00	0.0000E+00	1.1049E-04	4.0000E-02	3.5384E-05
83	2.2240E+03	1.0000E+00	0.0000E+00	1.1046E-04	4.0000E-02	2.3640E-05
84	2.2340E+03	1.0000E+00	0.0000E+00	1.1064E-04	4.0000E-02	9.8389E-05
85	2.2840E+03	1.0000E+00	0.0000E+00	1.1036E-04	4.0000E-02	1.0936E-06
86	2.3050E+03	1.0000E+00	0.0000E+00	1.1039E-04	4.0000E-02	1.9203E-05
87	2.3150E+03	1.0000E+00	0.0000E+00	1.1036E-04	4.0000E-02	5.4972E-06
88	2.3360E+03	1.0000E+00	0.0000E+00	1.1033E-04	4.0000E-02	1.1052E-06
89	2.3580E+03	1.0000E+00	0.0000E+00	1.1032E-04	4.0000E-02	3.3342E-06
90	2.3790E+03	1.0000E+00	0.0000E+00	1.1036E-04	4.0000E-02	2.4041E-05
91	2.4010E+03	1.0000E+00	0.0000E+00	1.1030E-04	4.0000E-02	2.2464E-06
92	2.4230E+03	1.0000E+00	0.0000E+00	1.1051E-04	4.0000E-02	8.7873E-05
93	2.4460E+03	1.0000E+00	0.0000E+00	1.1030E-04	4.0000E-02	1.3066E-05
94	2.4800E+03	1.0000E+00	0.0000E+00	1.1027E-04	4.0000E-02	6.2980E-06
95	2.5160E+03	1.0000E+00	0.0000E+00	1.1047E-04	4.0000E-02	8.3442E-05
96	2.5390E+03	1.0000E+00	0.0000E+00	1.1026E-04	4.0000E-02	1.8598E-05
97	2.5640E+03	1.0000E+00	0.0000E+00	1.1057E-04	4.0000E-02	1.3196E-04
98	2.6130E+03	1.0000E+00	0.0000E+00	1.1019E-04	4.0000E-02	7.6775E-06
99	2.6640E+03	1.0000E+00	0.0000E+00	1.1020E-04	4.0000E-02	1.6132E-05
100	2.7300E+03	1.0000E+00	0.0000E+00	1.1054E-04	4.0000E-02	1.5971E-04
101	2.7570E+03	1.0000E+00	0.0000E+00	1.1018E-04	4.0000E-02	3.2338E-05
102	2.7710E+03	1.0000E+00	0.0000E+00	1.1022E-04	4.0000E-02	5.0219E-05
103	2.8120E+03	1.0000E+00	0.0000E+00	1.1083E-04	4.0000E-02	7.9759E-06
104	2.8400E+03	1.0000E+00	0.0000E+00	1.1094E-04	4.0000E-02	4.7573E-05
105	2.8690E+03	1.0000E+00	0.0000E+00	1.1084E-04	4.0000E-02	1.6145E-05
106	2.8980E+03	1.0000E+00	0.0000E+00	1.1104E-04	4.0000E-02	8.8947E-05
107	2.9580E+03	1.0000E+00	0.0000E+00	1.1081E-04	4.0000E-02	1.2010E-05
108	3.0190E+03	1.0000E+00	0.0000E+00	1.1144E-04	4.0000E-02	2.5043E-04
109	3.0860E+03	1.0000E+00	0.0000E+00	1.1078E-04	4.0000E-02	1.2265E-05
110	3.1310E+03	1.0000E+00	0.0000E+00	1.1116E-04	4.0000E-02	1.5973E-04
111	3.1640E+03	1.0000E+00	0.0000E+00	1.1081E-04	4.0000E-02	3.4221E-05
112	3.1980E+03	1.0000E+00	0.0000E+00	1.1110E-04	4.0000E-02	1.4363E-04
113	3.2320E+03	1.0000E+00	0.0000E+00	1.1081E-04	4.0000E-02	4.2660E-05
114	3.2490E+03	1.0000E+00	0.0000E+00	1.1100E-04	4.0000E-02	1.1060E-04
115	3.3020E+03	1.0000E+00	0.0000E+00	1.1072E-04	4.0000E-02	1.4834E-05
116	3.3560E+03	1.0000E+00	0.0000E+00	1.1108E-04	4.0000E-02	1.5396E-04
117	3.3930E+03	1.0000E+00	0.0000E+00	1.1072E-04	4.0000E-02	2.4672E-05
118	3.4500E+03	1.0000E+00	0.0000E+00	1.1098E-04	4.0000E-02	1.2713E-04
119	3.4880E+03	1.0000E+00	0.0000E+00	1.1071E-04	4.0000E-02	3.2746E-05
120	3.5470E+03	1.0000E+00	0.0000E+00	1.1065E-04	4.0000E-02	1.6876E-05
121	3.6070E+03	1.0000E+00	0.0000E+00	1.1074E-04	4.0000E-02	5.5495E-05
122	3.6900E+03	1.0000E+00	0.0000E+00	1.1062E-04	4.0000E-02	2.3034E-05
123	3.7540E+03	1.0000E+00	0.0000E+00	1.1096E-04	4.0000E-02	1.5278E-04
124	3.8640E+03	1.0000E+00	0.0000E+00	1.1053E-04	4.0000E-02	8.1295E-06
125	3.9100E+03	1.0000E+00	0.0000E+00	1.1078E-04	4.0000E-02	1.0531E-04
126	4.0270E+03	1.0000E+00	0.0000E+00	1.1052E-04	4.0000E-02	2.2725E-05
127	4.0760E+03	1.0000E+00	0.0000E+00	1.1062E-04	4.0000E-02	6.4997E-05
128	4.3310E+03	1.0000E+00	0.0000E+00	1.1049E-04	4.0000E-02	4.6662E-05
129	4.3860E+03	1.0000E+00	0.0000E+00	1.1056E-04	4.0000E-02	7.9053E-05
130	4.4970E+03	1.0000E+00	0.0000E+00	1.1037E-04	4.0000E-02	2.1004E-05
131	4.6720E+03	1.0000E+00	0.0000E+00	1.1044E-04	4.0000E-02	2.1266E-04
132	4.7940E+03	1.0000E+00	0.0000E+00	1.0993E-04	4.0000E-02	2.5195E-05
133	4.9540E+03	1.0000E+00	0.0000E+00	1.1014E-04	4.0000E-02	1.0211E-04
134	4.0000E+04	1.0000E+00	0.0000E+00	1.1062E-04	4.0000E-02	2.7916E-04

L VALUE---------------------- 1
NUMBER OF J STATES------------ 4

DEGREES OF FREEDOM USED IN THE WIDTH DISTRIBUTION

J-VALUE	COMPETITIVE	NEUTRON	RADIATION	FISSION
1.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	1.0000E+00

AVERAGE RESONANCE WIDTHS (EV)

INDEX	ENERGY (EV)	LEVEL SPACING	COMPETITIVE	NEUTRON	RADIATION	FISSION
1	1.3000E+02	1.0000E+00	0.0000E+00	1.3428E-04	4.0000E-02	5.4391E-06
2	1.9800E+02	1.0000E+00	0.0000E+00	1.3540E-04	4.0000E-02	3.0718E-04
3	2.0800E+02	1.0000E+00	0.0000E+00	1.3441E-04	4.0000E-02	2.8031E-06
4	2.3100E+02	1.0000E+00	0.0000E+00	1.3474E-04	4.0000E-02	9.1923E-05
5	2.4000E+02	1.0000E+00	0.0000E+00	1.3449E-04	4.0000E-02	1.3643E-05
6	2.4900E+02	1.0000E+00	0.0000E+00	1.3488E-04	4.0000E-02	1.2935E-04
7	2.5900E+02	1.0000E+00	0.0000E+00	1.3448E-04	4.0000E-02	3.1592E-06
8	2.7800E+02	1.0000E+00	0.0000E+00	1.3485E-04	4.0000E-02	1.1138E-04
9	2.8800E+02	1.0000E+00	0.0000E+00	1.3450E-04	4.0000E-02	3.3486E-06
10	3.3000E+02	1.0000E+00	0.0000E+00	1.3486E-04	4.0000E-02	9.9855E-05
11	3.4000E+02	1.0000E+00	0.0000E+00	1.3454E-04	4.0000E-02	3.6693E-06
12	3.6700E+02	1.0000E+00	0.0000E+00	1.3529E-04	4.0000E-02	2.2074E-04
13	3.7700E+02	1.0000E+00	0.0000E+00	1.3456E-04	4.0000E-02	3.8853E-06
14	4.1900E+02	1.0000E+00	0.0000E+00	1.3521E-04	4.0000E-02	1.9021E-04
15	4.2900E+02	1.0000E+00	0.0000E+00	1.3459E-04	4.0000E-02	4.1746E-06
16	4.6800E+02	1.0000E+00	0.0000E+00	1.3500E-04	4.0000E-02	1.2090E-04
17	4.7800E+02	1.0000E+00	0.0000E+00	1.3461E-04	4.0000E-02	4.4344E-06
18	5.4100E+02	1.0000E+00	0.0000E+00	1.3477E-04	4.0000E-02	4.9284E-05
19	5.5100E+02	1.0000E+00	0.0000E+00	1.3463E-04	4.0000E-02	4.8023E-06
20	5.7100E+02	1.0000E+00	0.0000E+00	1.3492E-04	4.0000E-02	8.9990E-05
21	5.8100E+02	1.0000E+00	0.0000E+00	1.3464E-04	4.0000E-02	4.9479E-06
22	6.5300E+02	1.0000E+00	0.0000E+00	1.3546E-04	4.0000E-02	2.5470E-04
23	6.6300E+02	1.0000E+00	0.0000E+00	1.3464E-04	4.0000E-02	5.3310E-06
24	7.0200E+02	1.0000E+00	0.0000E+00	1.3510E-04	4.0000E-02	1.4373E-04
25	7.1200E+02	1.0000E+00	0.0000E+00	1.3464E-04	4.0000E-02	5.5511E-06
26	7.8700E+02	1.0000E+00	0.0000E+00	1.3532E-04	4.0000E-02	2.1128E-04
27	7.9700E+02	1.0000E+00	0.0000E+00	1.3463E-04	4.0000E-02	5.9191E-06
28	8.5900E+02	1.0000E+00	0.0000E+00	1.3565E-04	4.0000E-02	3.1373E-04
29	8.6900E+02	1.0000E+00	0.0000E+00	1.3462E-04	4.0000E-02	6.2191E-06
30	9.4100E+02	1.0000E+00	0.0000E+00	1.3463E-04	4.0000E-02	1.0742E-05
31	9.5100E+02	1.0000E+00	0.0000E+00	1.3460E-04	4.0000E-02	6.5490E-06
32	1.0060E+03	1.0000E+00	0.0000E+00	1.3542E-04	4.0000E-02	2.5609E-04
33	1.0150E+03	1.0000E+00	0.0000E+00	1.3462E-04	4.0000E-02	1.7004E-05
34	1.0220E+03	1.0000E+00	0.0000E+00	1.3471E-04	4.0000E-02	4.4391E-05
35	1.0320E+03	1.0000E+00	0.0000E+00	1.3459E-04	4.0000E-02	6.8636E-06
36	1.0850E+03	1.0000E+00	0.0000E+00	1.3495E-04	4.0000E-02	1.2102E-04
37	1.0920E+03	1.0000E+00	0.0000E+00	1.3466E-04	4.0000E-02	3.5497E-05
38	1.1210E+03	1.0000E+00	0.0000E+00	1.3571E-04	4.0000E-02	3.5439E-04
39	1.1310E+03	1.0000E+00	0.0000E+00	1.3456E-04	4.0000E-02	7.2361E-06
40	1.1990E+03	1.0000E+00	0.0000E+00	1.3478E-04	4.0000E-02	8.1452E-05
41	1.2090E+03	1.0000E+00	0.0000E+00	1.3452E-04	4.0000E-02	7.5211E-06
42	1.2300E+03	1.0000E+00	0.0000E+00	1.3550E-04	4.0000E-02	3.0127E-04
43	1.2400E+03	1.0000E+00	0.0000E+00	1.3451E-04	4.0000E-02	7.6323E-06
44	1.2730E+03	1.0000E+00	0.0000E+00	1.3564E-04	4.0000E-02	3.5073E-04
45	1.2830E+03	1.0000E+00	0.0000E+00	1.3449E-04	4.0000E-02	7.7846E-06
46	1.3130E+03	1.0000E+00	0.0000E+00	1.3462E-04	4.0000E-02	5.0586E-05
47	1.3230E+03	1.0000E+00	0.0000E+00	1.3449E-04	4.0000E-02	7.9241E-06
48	1.3760E+03	1.0000E+00	0.0000E+00	1.3517E-04	4.0000E-02	2.2033E-04
49	1.3860E+03	1.0000E+00	0.0000E+00	1.3445E-04	4.0000E-02	8.1419E-06
50	1.4290E+03	1.0000E+00	0.0000E+00	1.3310E-04	4.0000E-02	7.6345E-05
51	1.4390E+03	1.0000E+00	0.0000E+00	1.3443E-04	4.0000E-02	8.3214E-06
52	1.4600E+03	1.0000E+00	0.0000E+00	1.3455E-04	4.0000E-02	4.8745E-05
53	1.4700E+03	1.0000E+00	0.0000E+00	1.3441E-04	4.0000E-02	8.4257E-06
54	1.4990E+03	1.0000E+00	0.0000E+00	1.3449E-04	4.0000E-02	3.3268E-05
55	1.5090E+03	1.0000E+00	0.0000E+00	1.3441E-04	4.0000E-02	8.5545E-06
56	1.5470E+03	1.0000E+00	0.0000E+00	1.3457E-04	4.0000E-02	6.3502E-05
57	1.5570E+03	1.0000E+00	0.0000E+00	1.3437E-04	4.0000E-02	8.7129E-06
58	1.5780E+03	1.0000E+00	0.0000E+00	1.3467E-04	4.0000E-02	9.6928E-05
59	1.5880E+03	1.0000E+00	0.0000E+00	1.3436E-04	4.0000E-02	8.8137E-06
60	1.6220E+03	1.0000E+00	0.0000E+00	1.3437E-04	4.0000E-02	1.7854E-05
61	1.6320E+03	1.0000E+00	0.0000E+00	1.3433E-04	4.0000E-02	8.9557E-06
62	1.6740E+03	1.0000E+00	0.0000E+00	1.3463E-04	4.0000E-02	1.0448E-04
63	1.6840E+03	1.0000E+00	0.0000E+00	1.3432E-04	4.0000E-02	9.1212E-06

64	1,7040E+03	1.0000E+00	0,0000E+00	1,3491E-04	4.0000E-02	1,9614E-04
65	1,7140E+03	1.0000E+00	0,0000E+00	1,3430E-04	4.0000E-02	9,2157E-06
66	1,7340E+03	1.0000E+00	0,0000E+00	1,3459E-04	4.0000E-02	9,7769E-05
67	1,7440E+03	1.0000E+00	0,0000E+00	1,3428E-04	4.0000E-02	9,3101E-06
68	1,8700E+03	1.0000E+00	0,0000E+00	1,3664E-04	4.0000E-02	7,5674E-04
69	1,8800E+03	1.0000E+00	0,0000E+00	1,3421E-04	4.0000E-02	9,7290E-06
70	1,8960E+03	1.0000E+00	0,0000E+00	1,3450E-04	4.0000E-02	9,8610E-05
71	1,9060E+03	1.0000E+00	0,0000E+00	1,3420E-04	4.0000E-02	9,8077E-06
72	1,9240E+03	1.0000E+00	0,0000E+00	1,3444E-04	4.0000E-02	8,4718E-05
73	1,9340E+03	1.0000E+00	0,0000E+00	1,3418E-04	4.0000E-02	9,8926E-06
74	1,9970E+03	1.0000E+00	0,0000E+00	1,3434E-04	4.0000E-02	7,0734E-05
75	2,0070E+03	1.0000E+00	0,0000E+00	1,3414E-04	4.0000E-02	1,0110E-05
76	2,0390E+03	1.0000E+00	0,0000E+00	1,3422E-04	4.0000E-02	3,8330E-05
77	2,1010E+03	1.0000E+00	0,0000E+00	1,3406E-04	4.0000E-02	6,7532E-06
78	2,1280E+03	1.0000E+00	0,0000E+00	1,3408E-04	4.0000E-02	1,7795E-05
79	2,1560E+03	1.0000E+00	0,0000E+00	1,3402E-04	4.0000E-02	3,6900E-06
80	2,1750E+03	1.0000E+00	0,0000E+00	1,3403E-04	4.0000E-02	1,0630E-05
81	2,1850E+03	1.0000E+00	0,0000E+00	1,3401E-04	4.0000E-02	4,7820E-06
82	2,2140E+03	1.0000E+00	0,0000E+00	1,3409E-04	4.0000E-02	3,5384E-05
83	2,2240E+03	1.0000E+00	0,0000E+00	1,3405E-04	4.0000E-02	2,3640E-05
84	2,2540E+03	1.0000E+00	0,0000E+00	1,3427E-04	4.0000E-02	9,8389E-05
85	2,2840E+03	1.0000E+00	0,0000E+00	1,3394E-04	4.0000E-02	1,0906E-06
86	2,3050E+03	1.0000E+00	0,0000E+00	1,3398E-04	4.0000E-02	1,9203E-05
87	2,3150E+03	1.0000E+00	0,0000E+00	1,3394E-04	4.0000E-02	5,4972E-06
88	2,3360E+03	1.0000E+00	0,0000E+00	1,3390E-04	4.0000E-02	1,1092E-06
89	2,3580E+03	1.0000E+00	0,0000E+00	1,3389E-04	4.0000E-02	3,3342E-06
90	2,3790E+03	1.0000E+00	0,0000E+00	1,3394E-04	4.0000E-02	2,4041E-05
91	2,4010E+03	1.0000E+00	0,0000E+00	1,3387E-04	4.0000E-02	2,2464E-06
92	2,4230E+03	1.0000E+00	0,0000E+00	1,3412E-04	4.0000E-02	8,7873E-05
93	2,4460E+03	1.0000E+00	0,0000E+00	1,3387E-04	4.0000E-02	1,3066E-05
94	2,4800E+03	1.0000E+00	0,0000E+00	1,3383E-04	4.0000E-02	6,2980E-06
95	2,5160E+03	1.0000E+00	0,0000E+00	1,3407E-04	4.0000E-02	8,3442E-05
96	2,5390E+03	1.0000E+00	0,0000E+00	1,3381E-04	4.0000E-02	1,8598E-05
97	2,5640E+03	1.0000E+00	0,0000E+00	1,3419E-04	4.0000E-02	1,3196E-04
98	2,6130E+03	1.0000E+00	0,0000E+00	1,3373E-04	4.0000E-02	7,6775E-06
99	2,6640E+03	1.0000E+00	0,0000E+00	1,3375E-04	4.0000E-02	1,6132E-05
100	2,7300E+03	1.0000E+00	0,0000E+00	1,3416E-04	4.0000E-02	1,5971E-04
101	2,7570E+03	1.0000E+00	0,0000E+00	1,3372E-04	4.0000E-02	3,2338E-05
102	2,7710E+03	1.0000E+00	0,0000E+00	1,3376E-04	4.0000E-02	5,0219E-05
103	2,8120E+03	1.0000E+00	0,0000E+00	1,3451E-04	4.0000E-02	7,9799E-06
104	2,8400E+03	1.0000E+00	0,0000E+00	1,3464E-04	4.0000E-02	4,7573E-05
105	2,8690E+03	1.0000E+00	0,0000E+00	1,3452E-04	4.0000E-02	1,6145E-05
106	2,8980E+03	1.0000E+00	0,0000E+00	1,3476E-04	4.0000E-02	8,8947E-05
107	2,9580E+03	1.0000E+00	0,0000E+00	1,3448E-04	4.0000E-02	1,2010E-05
108	3,0190E+03	1.0000E+00	0,0000E+00	1,3525E-04	4.0000E-02	2,5043E-04
109	3,0660E+03	1.0000E+00	0,0000E+00	1,3444E-04	4.0000E-02	1,2265E-05
110	3,1310E+03	1.0000E+00	0,0000E+00	1,3491E-04	4.0000E-02	1,5903E-04
111	3,1640E+03	1.0000E+00	0,0000E+00	1,3448E-04	4.0000E-02	3,4221E-05
112	3,1980E+03	1.0000E+00	0,0000E+00	1,3484E-04	4.0000E-02	1,4363E-04
113	3,2320E+03	1.0000E+00	0,0000E+00	1,3449E-04	4.0000E-02	4,2660E-05
114	3,2490E+03	1.0000E+00	0,0000E+00	1,3471E-04	4.0000E-02	1,1060E-04
115	3,3020E+03	1.0000E+00	0,0000E+00	1,3437E-04	4.0000E-02	1,4834E-05
116	3,3560E+03	1.0000E+00	0,0000E+00	1,3481E-04	4.0000E-02	1,5396E-04
117	3,3930E+03	1.0000E+00	0,0000E+00	1,3437E-04	4.0000E-02	2,4672E-05
118	3,4500E+03	1.0000E+00	0,0000E+00	1,3469E-04	4.0000E-02	1,2713E-04
119	3,4880E+03	1.0000E+00	0,0000E+00	1,3436E-04	4.0000E-02	3,2746E-05
120	3,5470E+03	1.0000E+00	0,0000E+00	1,3429E-04	4.0000E-02	1,6876E-05
121	3,6070E+03	1.0000E+00	0,0000E+00	1,3440E-04	4.0000E-02	5,5495E-05
122	3,6900E+03	1.0000E+00	0,0000E+00	1,3426E-04	4.0000E-02	2,3034E-05
123	3,7540E+03	1.0000E+00	0,0000E+00	1,3467E-04	4.0000E-02	1,5278E-04
124	3,8640E+03	1.0000E+00	0,0000E+00	1,3414E-04	4.0000E-02	8,1295E-06
125	3,9100E+03	1.0000E+00	0,0000E+00	1,3445E-04	4.0000E-02	1,0531E-04
126	4,0270E+03	1.0000E+00	0,0000E+00	1,3413E-04	4.0000E-02	2,2725E-05
127	4,0760E+03	1.0000E+00	0,0000E+00	1,3425E-04	4.0000E-02	6,4997E-05
128	4,3310E+03	1.0000E+00	0,0000E+00	1,3409E-04	4.0000E-02	4,6662E-05
129	4,3860E+03	1.0000E+00	0,0000E+00	1,3418E-04	4.0000E-02	7,9053E-05
130	4,4970E+03	1.0000E+00	0,0000E+00	1,3395E-04	4.0000E-02	2,1034E-05
131	4,6720E+03	1.0000E+00	0,0000E+00	1,3404E-04	4.0000E-02	2,1266E-04
132	4,7940E+03	1.0000E+00	0,0000E+00	1,3342E-04	4.0000E-02	2,5195E-05
133	4,9540E+03	1.0000E+00	0,0000E+00	1,3367E-04	4.0000E-02	1,0211E-04
134	4,0000E+04	1.0000E+00	0,0000E+00	1,3425E-04	4.0000E-02	2,7916E-04

		DEGREES OF FREEDOM USED IN THE WIDTH DISTRIBUTION			
J-VALUE		COMPETITIVE	NEUTRON	RADIATION	FISSION
2.0000E+00		0.0000E+00	1.0000E+00	0.0000E+00	1.0000E+00

			AVERAGE RESONANCE WIDTHS (EV)			
INDEX	ENERGY (EV)	LEVEL SPACING	COMPETITIVE	NEUTRON	RADIATION	FISSION
1	1.3000E+02	1.0000E+00	0.0000E+00	1.3428E-04	4.0000E-02	5.4391E-06
2	1.9800E+02	1.0000E+00	0.0000E+00	1.3540E-04	4.0000E-02	3.0718E-04
3	2.0000E+02	1.0000E+00	0.0000E+00	1.3441E-04	4.0000E-02	2.8031E-06
4	2.3100E+02	1.0000E+00	0.0000E+00	1.3474E-04	4.0000E-02	9.1923E-05
5	2.4000E+02	1.0000E+00	0.0000E+00	1.3449E-04	4.0000E-02	1.3643E-05
6	2.4900E+02	1.0000E+00	0.0000E+00	1.3488E-04	4.0000E-02	1.2935E-04
7	2.5900E+02	1.0000E+00	0.0000E+00	1.3448E-04	4.0000E-02	3.1592E-06
8	2.7800E+02	1.0000E+00	0.0000E+00	1.3485E-04	4.0000E-02	1.1138E-04
9	2.8800E+02	1.0000E+00	0.0000E+00	1.3450E-04	4.0000E-02	3.3486E-06
10	3.3000E+02	1.0000E+00	0.0000E+00	1.3486E-04	4.0000E-02	9.9855E-05
11	3.4000E+02	1.0000E+00	0.0000E+00	1.3454E-04	4.0000E-02	3.6693E-06
12	3.6700E+02	1.0000E+00	0.0000E+00	1.3529E-04	4.0000E-02	2.2074E-04
13	3.7700E+02	1.0000E+00	0.0000E+00	1.3456E-04	4.0000E-02	3.8853E-06
14	4.1900E+02	1.0000E+00	0.0000E+00	1.3521E-04	4.0000E-02	1.9021E-04
15	4.2900E+02	1.0000E+00	0.0000E+00	1.3459E-04	4.0000E-02	4.1746E-06
16	4.6000E+02	1.0000E+00	0.0000E+00	1.3500E-04	4.0000E-02	1.2090E-04
17	4.7000E+02	1.0000E+00	0.0000E+00	1.3461E-04	4.0000E-02	4.4344E-06
18	5.4100E+02	1.0000E+00	0.0000E+00	1.3477E-04	4.0000E-02	4.9284E-05
19	5.5100E+02	1.0000E+00	0.0000E+00	1.3463E-04	4.0000E-02	4.8023E-06
20	5.7100E+02	1.0000E+00	0.0000E+00	1.3492E-04	4.0000E-02	8.9990E-05
21	5.8100E+02	1.0000E+00	0.0000E+00	1.3464E-04	4.0000E-02	4.9479E-06
22	6.5300E+02	1.0000E+00	0.0000E+00	1.3546E-04	4.0000E-02	2.5470E-04
23	6.6300E+02	1.0000E+00	0.0000E+00	1.3464E-04	4.0000E-02	5.3310E-06
24	7.0200E+02	1.0000E+00	0.0000E+00	1.3510E-04	4.0000E-02	1.4373E-04
25	7.1200E+02	1.0000E+00	0.0000E+00	1.3464E-04	4.0000E-02	5.5511E-06
26	7.8700E+02	1.0000E+00	0.0000E+00	1.3532E-04	4.0000E-02	2.1128E-04
27	7.9700E+02	1.0000E+00	0.0000E+00	1.3463E-04	4.0000E-02	5.9191E-06
28	8.5900E+02	1.0000E+00	0.0000E+00	1.3565E-04	4.0000E-02	3.1373E-04
29	8.6900E+02	1.0000E+00	0.0000E+00	1.3462E-04	4.0000E-02	6.2191E-06
30	9.4100E+02	1.0000E+00	0.0000E+00	1.3463E-04	4.0000E-02	1.0742E-05
31	9.5100E+02	1.0000E+00	0.0000E+00	1.3460E-04	4.0000E-02	6.5490E-06
32	1.0060E+03	1.0000E+00	0.0000E+00	1.3542E-04	4.0000E-02	2.5609E-04
33	1.0150E+03	1.0000E+00	0.0000E+00	1.3462E-04	4.0000E-02	1.7004E-05
34	1.0220E+03	1.0000E+00	0.0000E+00	1.3471E-04	4.0000E-02	4.4391E-05
35	1.0320E+03	1.0000E+00	0.0000E+00	1.3459E-04	4.0000E-02	6.8636E-06
36	1.0850E+03	1.0000E+00	0.0000E+00	1.3495E-04	4.0000E-02	1.2102E-04
37	1.0920E+03	1.0000E+00	0.0000E+00	1.3466E-04	4.0000E-02	3.5497E-05
38	1.1210E+03	1.0000E+00	0.0000E+00	1.3571E-04	4.0000E-02	3.5439E-04
39	1.1310E+03	1.0000E+00	0.0000E+00	1.3456E-04	4.0000E-02	7.2361E-06
40	1.1990E+03	1.0000E+00	0.0000E+00	1.3478E-04	4.0000E-02	8.1452E-05
41	1.2090E+03	1.0000E+00	0.0000E+00	1.3452E-04	4.0000E-02	7.5211E-06
42	1.2300E+03	1.0000E+00	0.0000E+00	1.3550E-04	4.0000E-02	3.0127E-04
43	1.2400E+03	1.0000E+00	0.0000E+00	1.3451E-04	4.0000E-02	7.6323E-06
44	1.2730E+03	1.0000E+00	0.0000E+00	1.3564E-04	4.0000E-02	3.5073E-04
45	1.2830E+03	1.0000E+00	0.0000E+00	1.3449E-04	4.0000E-02	7.7846E-06
46	1.3130E+03	1.0000E+00	0.0000E+00	1.3462E-04	4.0000E-02	5.0586E-05
47	1.3230E+03	1.0000E+00	0.0000E+00	1.3449E-04	4.0000E-02	7.9241E-06
48	1.3760E+03	1.0000E+00	0.0000E+00	1.3517E-04	4.0000E-02	2.2033E-04
49	1.3860E+03	1.0000E+00	0.0000E+00	1.3445E-04	4.0000E-02	8.1419E-06
50	1.4290E+03	1.0000E+00	0.0000E+00	1.3310E-04	4.0000E-02	7.6345E-05
51	1.4390E+03	1.0000E+00	0.0000E+00	1.3443E-04	4.0000E-02	8.3214E-06
52	1.4600E+03	1.0000E+00	0.0000E+00	1.3455E-04	4.0000E-02	4.8745E-05
53	1.4700E+03	1.0000E+00	0.0000E+00	1.3441E-04	4.0000E-02	8.4257E-06
54	1.4990E+03	1.0000E+00	0.0000E+00	1.3449E-04	4.0000E-02	3.3268E-05
55	1.5090E+03	1.0000E+00	0.0000E+00	1.3441E-04	4.0000E-02	8.5545E-06
56	1.5470E+03	1.0000E+00	0.0000E+00	1.3457E-04	4.0000E-02	6.3592E-05
57	1.5570E+03	1.0000E+00	0.0000E+00	1.3437E-04	4.0000E-02	8.7129E-06
58	1.5780E+03	1.0000E+00	0.0000E+00	1.3467E-04	4.0000E-02	9.6928E-05
59	1.5880E+03	1.0000E+00	0.0000E+00	1.3436E-04	4.0000E-02	8.8137E-06
60	1.6220E+03	1.0000E+00	0.0000E+00	1.3437E-04	4.0000E-02	1.7854E-05
61	1.6320E+03	1.0000E+00	0.0000E+00	1.3433E-04	4.0000E-02	8.9557E-06
62	1.6740E+03	1.0000E+00	0.0000E+00	1.3463E-04	4.0000E-02	1.0448E-04
63	1.6840E+03	1.0000E+00	0.0000E+00	1.3432E-04	4.0000E-02	9.1212E-06

64	1,7040E+03	1.0000E+00	0,0000E+00	1,3491E-04	4.0000E-02	1,9614E-04
65	1,7140E+03	1.0000E+00	0.0000E+00	1,3430E-04	4.0000E-02	9,2157E-06
66	1,7340E+03	1.0000E+00	0,0000E+00	1,3459E-04	4.0000E-02	9.7769E-05
67	1,7440E+03	1.0000E+00	0,0000E+00	1,3428E-04	4.0000E-02	9,3101E-06
68	1,8700E+03	1.0000E+00	0.0000E+00	1,3664E-04	4,0000E-02	7,5674E-04
69	1,8800E+03	1.0000E+00	0,0000E+00	1,3421E-04	4,0000E-02	9,7290E-06
70	1,8960E+03	1.0000E+00	0,0000E+00	1,3450E-04	4.0000E-02	9,8610E-05
71	1,9060E+03	1.0000E+00	0,0000E+00	1,3420E-04	4.0000E-02	9,8077E-06
72	1,9240E+03	1.0000E+00	0.0000E+00	1,3444E-04	4.0000E-02	8.4718E-05
73	1,9340E+03	1.0000E+00	0,0000E+00	1,3418E-04	4,0000E-02	9,8926E-06
74	1,9970E+03	1.0000E+00	0,0000E+00	1,3434E-04	4.0000E-02	7,0734E-05
75	2,0070E+03	1.0000E+00	0,0000E+00	1,3414E-04	4.0000E-02	1,0110E-05
76	2,0390E+03	1.0000E+00	0.0000E+00	1,3422E-04	4.0000E-02	3.8308E-05
77	2,1010E+03	1.0000E+00	0,0000E+00	1,3406E-04	4.0000E-02	6,7502E-06
78	2,1280E+03	1.0000E+00	0,0000E+00	1,3408E-04	4.0000E-02	1,7795E-05
79	2,1560E+03	1.0000E+00	0,0000E+00	1,3402E-04	4.0000E-02	3,6900E-06
80	2,1750E+03	1.0000E+00	0,0000E+00	1,3403E-04	4.0000E-02	1,0600E-05
81	2,1850E+03	1.0000E+00	0,0000E+00	1,3401E-04	4.0000E-02	4,7820E-06
82	2,2140E+03	1,0000E+00	0,0000E+00	1,3409E-04	4.0000E-02	3,5394E-05
83	2,2240E+03	1.0000E+00	0,0000E+00	1,3405E-04	4.0000E-02	2,3640E-05
84	2,2540E+03	1.0000E+00	0,0000E+00	1,3427E-04	4,0000E-02	9,8389E-05
85	2,2840E+03	1,0000E+00	0,0000E+00	1.3394E-04	4.0000E-02	1,0906E-06
86	2,3050E+03	1.0000E+00	0,0000E+00	1,3398E-04	4.0000E-02	1,9203E-05
87	2,3150E+03	1,0000E+00	0,0000E+00	1,3394E-04	4,0000E-02	5,4972E-06
88	2,3360E+03	1.0000E+00	0.0000E+00	1,3390E-04	4.0000E-02	1,1052E-06
89	2,3580E+03	1.0000E+00	0,0000E+00	1,3389E-04	4.0000E-02	3,3342E-06
90	2,3790E+03	1.0000E+00	0.0000E+00	1,3394E-04	4.0000E-02	2,4041E-05
91	2,4010E+03	1,0000E+00	0,0000E+00	1,3387E-04	4,0000E-02	2,2464E-06
92	2,4230E+03	1,0000E+00	0,0000E+00	1,3412E-04	4,0000E-02	8,7873E-05
93	2,4460E+03	1.0000E+00	0,0000E+00	1,3387E-04	4.0000E-02	1,3066E-05
94	2,4800E+03	1,0000E+00	0,0000E+00	1,3383E-04	4,0000E-02	6,2980E-06
95	2,5160E+03	1.0000E+00	0,0000E+00	1,3407E-04	4.0000E-02	8,3442E-05
96	2,5390E+03	1.0000E+00	0,0000E+00	1,3381E-04	4.0000E-02	1,8588E-05
97	2,5640E+03	1,0000E+00	0.0000E+00	1,3419E-04	4.0000E-02	1,3196E-04
98	2,6130E+03	1,0000E+00	0,0000E+00	1,3373E-04	4,0000E-02	7,6775E-06
99	2,6640E+03	1,0000E+00	0,0000E+00	1,3375E-04	4,0000E-02	1,6132E-05
100	2,7300E+03	1,0000E+00	0,0000E+00	1,3416E-04	4.0000E-02	1,5971E-04
101	2,7570E+03	1,0000E+00	0,0000E+00	1,3372E-04	4.0000E-02	3,2338E-05
102	2,7710E+03	1.0000E+00	0,0000E+00	1,3376E-04	4.0000E-02	5,0219E-05
103	2,8120E+03	1.0000E+00	0,0000E+00	1,3451E-04	4.0000E-02	7,9759E-06
104	2,8400E+03	1.0000E+00	0,0000E+00	1,3464E-04	4,0000E-02	4,7573E-05
105	2,8690E+03	1.0000E+00	0,0000E+00	1,3452E-04	4.0000E-02	1,6145E-05
106	2,8980E+03	1.0000E+00	0.0000E+00	1,3476E-04	4.0000E-02	8.8947E-05
107	2,9580E+03	1,0000E+00	0,0000E+00	1,3448E-04	4.0000E-02	1,2010E-05
108	3,0190E+03	1.0000E+00	0,0000E+00	1,3525E-04	4,0000E-02	2,5043E-04
109	3,0660E+03	1,0000E+00	0,0000E+00	1,3444E-04	4,0000E-02	1,2265E-05
110	3,1310E+03	1,0000E+00	0,0000E+00	1,3491E-04	4,0000E-02	1,5903E-04
111	3,1640E+03	1,0000E+00	0,0000E+00	1,3448E-04	4,0000E-02	3,4221E-05
112	3,1980E+03	1.0000E+00	0,0000E+00	1,3484E-04	4.0000E-02	1,4363E-04
113	3,2320E+03	1.0000E+00	0,0000E+00	1,3449E-04	4,0000E-02	4,2680E-05
114	3,2490E+03	1,0000E+00	0,0000E+00	1,3471E-04	4,0000E-02	1,1060E-04
115	3,3020E+03	1.0000E+00	0,0000E+00	1,3437E-04	4,0000E-02	1,4834E-05
116	3,3560E+03	1,0000E+00	0,0000E+00	1,3481E-04	4,0000E-02	1,5396E-04
117	3,3930E+03	1.0000E+00	0,0000E+00	1,3437E-04	4.0000E-02	2,4672E-05
118	3,4500E+03	1,0000E+00	0,0000E+00	1,3469E-04	4,0000E-02	1,2713E-04
119	3,4880E+03	1.0000E+00	0,0000E+00	1,3436E-04	4.0000E-02	3,2746E-05
120	3,5470E+03	1.0000E+00	0,0000E+00	1,3429E-04	4.0000E-02	1,6876E-05
121	3,6070E+03	1,0000E+00	0,0000E+00	1,3440E-04	4.0000E-02	5,5495E-05
122	3,6900E+03	1,0000E+00	0,0000E+00	1,3426E-04	4,0000E-02	2,3034E-05
123	3,7540E+03	1,0000E+00	0,0000E+00	1,3467E-04	4,0000E-02	1,5278E-04
124	3,8640E+03	1,0000E+00	0,0000E+00	1,3414E-04	4,0000E-02	8,1295E-06
125	3,9100E+03	1.0000E+00	0,0000E+00	1,3445E-04	4,0000E-02	1,0531E-04
126	4,0270E+03	1,0000E+00	0,0000E+00	1,3413E-04	4.0000E-02	2,2725E-05
127	4,0760E+03	1,0000E+00	0,0000E+00	1,3425E-04	4,0000E-02	6,4997E-05
128	4,3310E+03	1.0000E+00	0,0000E+00	1,3409E-04	4,0000E-02	4,6662E-05
129	4,3860E+03	1,0000E+00	0,0000E+00	1,3418E-04	4.0000E-02	7,9053E-05
130	4,4970E+03	1.0000E+00	0,0000E+00	1,3395E-04	4,0000E-02	2.1004E-05
131	4,6720E+03	1,0000E+00	0,0000E+00	1,3404E-04	4.0000E-02	2,1266E-04
132	4,7940E+03	1,0000E+00	0,0000E+00	1,3342E-04	4.0000E-02	2,5195E-05
133	4,9540E+03	1,0000E+00	0,0000E+00	1,3367E-04	4,0000E-02	1,0211E-04
134	4,0000E+04	1.0000E+00	0,0000E+00	1,3425E-04	4.0000E-02	2,7916E-04

	DEGREES OF FREEDOM USED IN THE WIDTH DISTRIBUTION				
J-VALUE	COMPETITIVE	NEUTRON	RADIATION	FISSION
3.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	1.0000E+00

INDEX	ENERGY (EV)	LEVEL SPACING	AVERAGE RESONANCE WIDTHS (EV) COMPETITIVE	NEUTRON	RADIATION	FISSION
1	1.3000E+02	1.0000E+00	0.0000E+00	1.3428E-04	4.0000E-02	5.4391E-06
2	1.9800E+02	1.0000E+00	0.0000E+00	1.3540E-04	4.0000E-02	3.0718E-04
3	2.0800E+02	1.0000E+00	0.0000E+00	1.3441E-04	4.0000E-02	2.8031E-06
4	2.3100E+02	1.0000E+00	0.0000E+00	1.3474E-04	4.0000E-02	9.1923E-05
5	2.4000E+02	1.0000E+00	0.0000E+00	1.3449E-04	4.0000E-02	1.3643E-05
6	2.4900E+02	1.0000E+00	0.0000E+00	1.3488E-04	4.0000E-02	1.2935E-04
7	2.5900E+02	1.0000E+00	0.0000E+00	1.3448E-04	4.0000E-02	3.1592E-06
8	2.7800E+02	1.0000E+00	0.0000E+00	1.3485E-04	4.0000E-02	1.1138E-04
9	2.8800E+02	1.0000E+00	0.0000E+00	1.3450E-04	4.0000E-02	3.3486E-06
10	3.3000E+02	1.0000E+00	0.0000E+00	1.3486E-04	4.0000E-02	9.9855E-05
11	3.4000E+02	1.0000E+00	0.0000E+00	1.3454E-04	4.0000E-02	3.6693E-06
12	3.6700E+02	1.0000E+00	0.0000E+00	1.3529E-04	4.0000E-02	2.2074E-04
13	3.7700E+02	1.0000E+00	0.0000E+00	1.3456E-04	4.0000E-02	3.8853E-06
14	4.1900E+02	1.0000E+00	0.0000E+00	1.3521E-04	4.0000E-02	1.9021E-04
15	4.2900E+02	1.0000E+00	0.0000E+00	1.3459E-04	4.0000E-02	4.1746E-06
16	4.6800E+02	1.0000E+00	0.0000E+00	1.3500E-04	4.0000E-02	1.2090E-04
17	4.7800E+02	1.0000E+00	0.0000E+00	1.3461E-04	4.0000E-02	4.4344E-06
18	5.4100E+02	1.0000E+00	0.0000E+00	1.3477E-04	4.0000E-02	4.9284E-05
19	5.5100E+02	1.0000E+00	0.0000E+00	1.3463E-04	4.0000E-02	4.8023E-06
20	5.7100E+02	1.0000E+00	0.0000E+00	1.3492E-04	4.0000E-02	8.9990E-05
21	5.8100E+02	1.0000E+00	0.0000E+00	1.3464E-04	4.0000E-02	4.9479E-06
22	6.5300E+02	1.0000E+00	0.0000E+00	1.3546E-04	4.0000E-02	2.5470E-04
23	6.6300E+02	1.0000E+00	0.0000E+00	1.3464E-04	4.0000E-02	5.3310E-06
24	7.0200E+02	1.0000E+00	0.0000E+00	1.3510E-04	4.0000E-02	1.4373E-04
25	7.1200E+02	1.0000E+00	0.0000E+00	1.3464E-04	4.0000E-02	5.5511E-06
26	7.8700E+02	1.0000E+00	0.0000E+00	1.3532E-04	4.0000E-02	2.1128E-04
27	7.9700E+02	1.0000E+00	0.0000E+00	1.3463E-04	4.0000E-02	5.9191E-06
28	8.5900E+02	1.0000E+00	0.0000E+00	1.3565E-04	4.0000E-02	3.1373E-04
29	8.6900E+02	1.0000E+00	0.0000E+00	1.3462E-04	4.0000E-02	6.2191E-06
30	9.4100E+02	1.0000E+00	0.0000E+00	1.3463E-04	4.0000E-02	1.0742E-05
31	9.5100E+02	1.0000E+00	0.0000E+00	1.3460E-04	4.0000E-02	6.5490E-06
32	1.0060E+03	1.0000E+00	0.0000E+00	1.3542E-04	4.0000E-02	2.5609E-04
33	1.0150E+03	1.0000E+00	0.0000E+00	1.3462E-04	4.0000E-02	1.7004E-05
34	1.0220E+03	1.0000E+00	0.0000E+00	1.3471E-04	4.0000E-02	4.4391E-05
35	1.0320E+03	1.0000E+00	0.0000E+00	1.3459E-04	4.0000E-02	6.8636E-06
36	1.0850E+03	1.0000E+00	0.0000E+00	1.3495E-04	4.0000E-02	1.2102E-04
37	1.0920E+03	1.0000E+00	0.0000E+00	1.3466E-04	4.0000E-02	3.5497E-05
38	1.1210E+03	1.0000E+00	0.0000E+00	1.3571E-04	4.0000E-02	3.5439E-04
39	1.1310E+03	1.0000E+00	0.0000E+00	1.3456E-04	4.0000E-02	7.2361E-06
40	1.1990E+03	1.0000E+00	0.0000E+00	1.3478E-04	4.0000E-02	8.1452E-05
41	1.2090E+03	1.0000E+00	0.0000E+00	1.3452E-04	4.0000E-02	7.5211E-06
42	1.2300E+03	1.0000E+00	0.0000E+00	1.3550E-04	4.0000E-02	3.0127E-04
43	1.2400E+03	1.0000E+00	0.0000E+00	1.3451E-04	4.0000E-02	7.6323E-06
44	1.2730E+03	1.0000E+00	0.0000E+00	1.3564E-04	4.0000E-02	3.5073E-04
45	1.2830E+03	1.0000E+00	0.0000E+00	1.3449E-04	4.0000E-02	7.7846E-06
46	1.3130E+03	1.0000E+00	0.0000E+00	1.3462E-04	4.0000E-02	5.0586E-05
47	1.3230E+03	1.0000E+00	0.0000E+00	1.3449E-04	4.0000E-02	7.9241E-06
48	1.3760E+03	1.0000E+00	0.0000E+00	1.3517E-04	4.0000E-02	2.2033E-04
49	1.3860E+03	1.0000E+00	0.0000E+00	1.3445E-04	4.0000E-02	8.1419E-06
50	1.4290E+03	1.0000E+00	0.0000E+00	1.3310E-04	4.0000E-02	7.6345E-05
51	1.4390E+03	1.0000E+00	0.0000E+00	1.3443E-04	4.0000E-02	8.3214E-06
52	1.4600E+03	1.0000E+00	0.0000E+00	1.3455E-04	4.0000E-02	4.8745E-05
53	1.4700E+03	1.0000E+00	0.0000E+00	1.3441E-04	4.0000E-02	8.4257E-06
54	1.4990E+03	1.0000E+00	0.0000E+00	1.3449E-04	4.0000E-02	3.3268E-05
55	1.5090E+03	1.0000E+00	0.0000E+00	1.3441E-04	4.0000E-02	8.5545E-06
56	1.5470E+03	1.0000E+00	0.0000E+00	1.3457E-04	4.0000E-02	6.3532E-05
57	1.5570E+03	1.0000E+00	0.0000E+00	1.3437E-04	4.0000E-02	8.7129E-06
58	1.5780E+03	1.0000E+00	0.0000E+00	1.3467E-04	4.0000E-02	9.6928E-05
59	1.5880E+03	1.0000E+00	0.0000E+00	1.3436E-04	4.0000E-02	8.8137E-06
60	1.6220E+03	1.0000E+00	0.0000E+00	1.3437E-04	4.0000E-02	1.7854E-05
61	1.6320E+03	1.0000E+00	0.0000E+00	1.3433E-04	4.0000E-02	8.9557E-06
62	1.6740E+03	1.0000E+00	0.0000E+00	1.3463E-04	4.0000E-02	1.0448E-04
63	1.6840E+03	1.0000E+00	0.0000E+00	1.3432E-04	4.0000E-02	9.1212E-06

64	1,7040E+03	1.0000E+00	0,0000E+00	1,3491E-04	4.0000E-02	1.9614E-04
65	1,7140E+03	1.0000E+00	0,0000E+00	1,3430E-04	4.0000E-02	9.2157E-06
66	1,7340E+03	1.0000E+00	0,0000E+00	1,3459E-04	4.0000E-02	9.7769E-05
67	1,7440E+03	1.0000E+00	0,0000E+00	1,3428E-04	4.0000E-02	9.3131E-06
68	1,8700E+03	1.0000E+00	0,0000E+00	1,3664E-04	4.0000E-02	7,5674E-04
69	1,8800E+03	1.0000E+00	0,0000E+00	1,3421E-04	4.0000E-02	9.7290E-06
70	1,8960E+03	1.0000E+00	0,0000E+00	1,3450E-04	4.0000E-02	9.8610E-05
71	1,9060E+03	1.0000E+00	0,0000E+00	1,3420E-04	4.0000E-02	9.8077E-06
72	1,9240E+03	1.0000E+00	0,0000E+00	1,3444E-04	4.0000E-02	8.4718E-05
73	1,9340E+03	1.0000E+00	0,0000E+00	1,3418E-04	4.0000E-02	9.8926E-06
74	1,9970E+03	1.0000E+00	0,0000E+00	1,3434E-04	4.0000E-02	7,0734E-05
75	2,0070E+03	1.0000E+00	0,0000E+00	1,3414E-04	4.0000E-02	1,0110E-05
76	2,0390E+03	1.0000E+00	0,0000E+00	1,3422E-04	4.0000E-02	3.8308E-05
77	2,1010E+03	1.0000E+00	0,0000E+00	1,3406E-04	4.0000E-02	6.7502E-06
78	2,1280E+03	1.0000E+00	0,0000E+00	1,3408E-04	4.0000E-02	1.7795E-05
79	2,1560E+03	1.0000E+00	0,0000E+00	1,3402E-04	4.0000E-02	3,6900E-06
80	2,1750E+03	1.0000E+00	0,0000E+00	1,3403E-04	4.0000E-02	1.0600E-05
81	2,1850E+03	1.0000E+00	0,0000E+00	1,3401E-04	4.0000E-02	4,7820E-06
82	2,2140E+03	1.0000E+00	0,0000E+00	1,3409E-04	4.0000E-02	3,5384E-05
83	2,2240E+03	1.0000E+00	0,0000E+00	1,3405E-04	4.0000E-02	2,3640E-05
84	2,2540E+03	1.0000E+00	0,0000E+00	1,3427E-04	4.0000E-02	9,8389E-05
85	2,2840E+03	1.0000E+00	0,0000E+00	1,3394E-04	4.0000E-02	1,0936E-06
86	2,3090E+03	1.0000E+00	0,0000E+00	1,3398E-04	4.0000E-02	1,9233E-05
87	2,3150E+03	1.0000E+00	0,0000E+00	1,3394E-04	4.0000E-02	5.4972E-06
88	2,3360E+03	1.0000E+00	0,0000E+00	1,3390E-04	4.0000E-02	1,1032E-06
89	2,3580E+03	1.0000E+00	0,0000E+00	1,3389E-04	4.0000E-02	3,3342E-06
90	2,3790E+03	1.0000E+00	0,0000E+00	1,3394E-04	4.0000E-02	2,4041E-05
91	2,4010E+03	1.0000E+00	0,0000E+00	1,3387E-04	4.0000E-02	2,2464E-06
92	2,4230E+03	1.0000E+00	0,0000E+00	1,3412E-04	4.0000E-02	8,7873E-05
93	2,4460E+03	1.0000E+00	0,0000E+00	1,3387E-04	4.0000E-02	1,3066E-05
94	2,4800E+03	1.0000E+00	0,0000E+00	1,3383E-04	4.0000E-02	6,2980E-06
95	2,5160E+03	1.0000E+00	0,0000E+00	1,3407E-04	4.0000E-02	8,3442E-05
96	2,5390E+03	1.0000E+00	0,0000E+00	1,3381E-04	4.0000E-02	1.8588E-05
97	2,5640E+03	1.0000E+00	0,0000E+00	1,3419E-04	4.0000E-02	1,3196E-04
98	2,6130E+03	1.0000E+00	0,0000E+00	1,3373E-04	4.0000E-02	7,6775E-06
99	2,6640E+03	1.0000E+00	0,0000E+00	1,3375E-04	4.0000E-02	1,6132E-05
100	2,7300E+03	1.0000E+00	0,0000E+00	1,3416E-04	4.0000E-02	1,5971E-04
101	2,7570E+03	1.0000E+00	0,0000E+00	1,3372E-04	4.0000E-02	3.2338E-05
102	2,7710E+03	1.0000E+00	0,0000E+00	1,3376E-04	4.0000E-02	5,0219E-05
103	2,8120E+03	1.0000E+00	0,0000E+00	1,3451E-04	4.0000E-02	7.9759E-06
104	2,8400E+03	1.0000E+00	0,0000E+00	1,3464E-04	4.0000E-02	4,7573E-05
105	2,8690E+03	1.0000E+00	0,0000E+00	1,3452E-04	4.0000E-02	1,6145E-05
106	2,8980E+03	1.0000E+00	0,0000E+00	1,3476E-04	4.0000E-02	8,8947E-05
107	2,9580E+03	1.0000E+00	0,0000E+00	1,3448E-04	4.0000E-02	1,2010E-05
108	3,0190E+03	1.0000E+00	0,0000E+00	1,3525E-04	4.0000E-02	2,5043E-04
109	3,0660E+03	1.0000E+00	0,0000E+00	1,3444E-04	4.0000E-02	1.2265E-05
110	3,1310E+03	1.0000E+00	0,0000E+00	1,3491E-04	4.0000E-02	1,5923E-04
111	3,1640E+03	1.0000E+00	0,0000E+00	1,3448E-04	4.0000E-02	3,4221E-05
112	3,1980E+03	1.0000E+00	0,0000E+00	1,3484E-04	4.0000E-02	1,4363E-04
113	3,2320E+03	1.0000E+00	0,0000E+00	1,3449E-04	4.0000E-02	4,2660E-05
114	3,2490E+03	1.0000E+00	0,0000E+00	1,3471E-04	4.0000E-02	1.1060E-04
115	3,3020E+03	1.0000E+00	0,0000E+00	1,3437E-04	4.0000E-02	1,4834E-05
116	3,3560E+03	1.0000E+00	0,0000E+00	1,3481E-04	4.0000E-02	1.5396E-04
117	3,3930E+03	1.0000E+00	0,0000E+00	1,3437E-04	4.0000E-02	2.4672E-05
118	3,4500E+03	1.0000E+00	0,0000E+00	1,3469E-04	4.0000E-02	1,2713E-04
119	3,4880E+03	1.0000E+00	0,0000E+00	1,3436E-04	4.0000E-02	3,2746E-05
120	3,5470E+03	1.0000E+00	0,0000E+00	1,3429E-04	4.0000E-02	1,6876E-05
121	3,6070E+03	1.0000E+00	0,0000E+00	1,3440E-04	4.0000E-02	5,5495E-05
122	3,6900E+03	1.0000E+00	0,0000E+00	1,3426E-04	4.0000E-02	2.3034E-05
123	3,7540E+03	1.0000E+00	0,0000E+00	1,3467E-04	4.0000E-02	1.5278E-04
124	3,8640E+03	1.0000E+00	0,0000E+00	1,3414E-04	4.0000E-02	8.1295E-06
125	3,9100E+03	1.0000E+00	0,0000E+00	1,3445E-04	4.0000E-02	1.0531E-04
126	4,0270E+03	1.0000E+00	0,0000E+00	1,3413E-04	4.0000E-02	2,2725E-05
127	4,0760E+03	1.0000E+00	0,0000E+00	1,3425E-04	4.0000E-02	6,4997E-05
128	4,3310E+03	1.0000E+00	0,0000E+00	1,3409E-04	4.0000E-02	4,6662E-05
129	4,3860E+03	1.0000E+00	0,0000E+00	1,3418E-04	4.0000E-02	7.9053E-05
130	4,4970E+03	1.0000E+00	0,0000E+00	1,3395E-04	4.0000E-02	2,1004E-05
131	4,6720E+03	1.0000E+00	0,0000E+00	1,3404E-04	4.0000E-02	2,1266E-04
132	4,7940E+03	1.0000E+00	0,0000E+00	1,3342E-04	4.0000E-02	2,5195E-05
133	4,9540E+03	1.0000E+00	0,0000E+00	1,3367E-04	4.0000E-02	1,0211E-04
134	4,0000E+04	1.0000E+00	0,0000E+00	1,3425E-04	4.0000E-02	2,7916E-04

	J-VALUE	DEGREES OF FREEDOM USED IN THE WIDTH DISTRIBUTION: COMPETITIVE	NEUTRON	RADIATION	FISSION
	4.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	1.0000E+00

INDEX	ENERGY (EV)	LEVEL SPACING	AVERAGE RESONANCE WIDTHS (EV): COMPETITIVE	NEUTRON	RADIATION	FISSION
1	1.3000E+02	1.0000E+00	0.0000E+00	1.3428E-04	4.0000E-02	5.4391E-06
2	1.9800E+02	1.0000E+00	0.0000E+00	1.3540E-04	4.0000E-02	3.0718E-04
3	2.0800E+02	1.0000E+00	0.0000E+00	1.3441E-04	4.0000E-02	2.8031E-06
4	2.3100E+02	1.0000E+00	0.0000E+00	1.3474E-04	4.0000E-02	9.1923E-05
5	2.4000E+02	1.0000E+00	0.0000E+00	1.3449E-04	4.0000E-02	1.3643E-05
6	2.4900E+02	1.0000E+00	0.0000E+00	1.3488E-04	4.0000E-02	1.2935E-04
7	2.5900E+02	1.0000E+00	0.0000E+00	1.3448E-04	4.0000E-02	3.1592E-06
8	2.7800E+02	1.0000E+00	0.0000E+00	1.3485E-04	4.0000E-02	1.1138E-04
9	2.8800E+02	1.0000E+00	0.0000E+00	1.3450E-04	4.0000E-02	3.3486E-06
10	3.3000E+02	1.0000E+00	0.0000E+00	1.3486E-04	4.0000E-02	9.9855E-05
11	3.4000E+02	1.0000E+00	0.0000E+00	1.3454E-04	4.0000E-02	3.6693E-06
12	3.6700E+02	1.0000E+00	0.0000E+00	1.3529E-04	4.0000E-02	2.2074E-04
13	3.7700E+02	1.0000E+00	0.0000E+00	1.3456E-04	4.0000E-02	3.8853E-06
14	4.1900E+02	1.0000E+00	0.0000E+00	1.3521E-04	4.0000E-02	1.9021E-04
15	4.2900E+02	1.0000E+00	0.0000E+00	1.3459E-04	4.0000E-02	4.1746E-06
16	4.6800E+02	1.0000E+00	0.0000E+00	1.3500E-04	4.0000E-02	1.2090E-04
17	4.7800E+02	1.0000E+00	0.0000E+00	1.3461E-04	4.0000E-02	4.4344E-06
18	5.4100E+02	1.0000E+00	0.0000E+00	1.3477E-04	4.0000E-02	4.9284E-05
19	5.5100E+02	1.0000E+00	0.0000E+00	1.3463E-04	4.0000E-02	4.8023E-06
20	5.7100E+02	1.0000E+00	0.0000E+00	1.3492E-04	4.0000E-02	8.9990E-05
21	5.8100E+02	1.0000E+00	0.0000E+00	1.3464E-04	4.0000E-02	4.9479E-06
22	6.5300E+02	1.0000E+00	0.0000E+00	1.3546E-04	4.0000E-02	2.5470E-04
23	6.6300E+02	1.0000E+00	0.0000E+00	1.3464E-04	4.0000E-02	5.3310E-06
24	7.0200E+02	1.0000E+00	0.0000E+00	1.3510E-04	4.0000E-02	1.4373E-04
25	7.1200E+02	1.0000E+00	0.0000E+00	1.3464E-04	4.0000E-02	5.5511E-06
26	7.8700E+02	1.0000E+00	0.0000E+00	1.3532E-04	4.0000E-02	2.1128E-04
27	7.9700E+02	1.0000E+00	0.0000E+00	1.3463E-04	4.0000E-02	5.9191E-06
28	8.5900E+02	1.0000E+00	0.0000E+00	1.3565E-04	4.0000E-02	3.1373E-04
29	8.6900E+02	1.0000E+00	0.0000E+00	1.3462E-04	4.0000E-02	6.2191E-06
30	9.4100E+02	1.0000E+00	0.0000E+00	1.3463E-04	4.0000E-02	1.0742E-05
31	9.5100E+02	1.0000E+00	0.0000E+00	1.3460E-04	4.0000E-02	6.5490E-06
32	1.0060E+03	1.0000E+00	0.0000E+00	1.3542E-04	4.0000E-02	2.5609E-04
33	1.0150E+03	1.0000E+00	0.0000E+00	1.3462E-04	4.0000E-02	1.7004E-05
34	1.0220E+03	1.0000E+00	0.0000E+00	1.3471E-04	4.0000E-02	4.4391E-05
35	1.0320E+03	1.0000E+00	0.0000E+00	1.3459E-04	4.0000E-02	6.8636E-06
36	1.0850E+03	1.0000E+00	0.0000E+00	1.3495E-04	4.0000E-02	1.2102E-04
37	1.0920E+03	1.0000E+00	0.0000E+00	1.3466E-04	4.0000E-02	3.5497E-05
38	1.1210E+03	1.0000E+00	0.0000E+00	1.3571E-04	4.0000E-02	3.5439E-04
39	1.1310E+03	1.0000E+00	0.0000E+00	1.3456E-04	4.0000E-02	7.2361E-06
40	1.1990E+03	1.0000E+00	0.0000E+00	1.3478E-04	4.0000E-02	8.1452E-05
41	1.2090E+03	1.0000E+00	0.0000E+00	1.3452E-04	4.0000E-02	7.5211E-06
42	1.2300E+03	1.0000E+00	0.0000E+00	1.3550E-04	4.0000E-02	3.0127E-04
43	1.2400E+03	1.0000E+00	0.0000E+00	1.3451E-04	4.0000E-02	7.6323E-06
44	1.2730E+03	1.0000E+00	0.0000E+00	1.3564E-04	4.0000E-02	3.5073E-04
45	1.2830E+03	1.0000E+00	0.0000E+00	1.3449E-04	4.0000E-02	7.7846E-06
46	1.3130E+03	1.0000E+00	0.0000E+00	1.3462E-04	4.0000E-02	5.0586E-05
47	1.3230E+03	1.0000E+00	0.0000E+00	1.3449E-04	4.0000E-02	7.9241E-06
48	1.3760E+03	1.0000E+00	0.0000E+00	1.3517E-04	4.0000E-02	2.2033E-04
49	1.3860E+03	1.0000E+00	0.0000E+00	1.3445E-04	4.0000E-02	8.1419E-06
50	1.4290E+03	1.0000E+00	0.0000E+00	1.3310E-04	4.0000E-02	7.6345E-05
51	1.4390E+03	1.0000E+00	0.0000E+00	1.3443E-04	4.0000E-02	8.3214E-06
52	1.4600E+03	1.0000E+00	0.0000E+00	1.3455E-04	4.0000E-02	4.8745E-05
53	1.4700E+03	1.0000E+00	0.0000E+00	1.3441E-04	4.0000E-02	8.4257E-06
54	1.4990E+03	1.0000E+00	0.0000E+00	1.3449E-04	4.0000E-02	3.3268E-05
55	1.5090E+03	1.0000E+00	0.0000E+00	1.3441E-04	4.0000E-02	8.5545E-06
56	1.5470E+03	1.0000E+00	0.0000E+00	1.3457E-04	4.0000E-02	6.3502E-05
57	1.5570E+03	1.0000E+00	0.0000E+00	1.3437E-04	4.0000E-02	8.7129E-06
58	1.5780E+03	1.0000E+00	0.0000E+00	1.3467E-04	4.0000E-02	9.6928E-05
59	1.5880E+03	1.0000E+00	0.0000E+00	1.3436E-04	4.0000E-02	8.8137E-06
60	1.6220E+03	1.0000E+00	0.0000E+00	1.3437E-04	4.0000E-02	1.7854E-05
61	1.6320E+03	1.0000E+00	0.0000E+00	1.3433E-04	4.0000E-02	8.9557E-06
62	1.6740E+03	1.0000E+00	0.0000E+00	1.3463E-04	4.0000E-02	1.0448E-04
63	1.6840E+03	1.0000E+00	0.0000E+00	1.3432E-04	4.0000E-02	9.1212E-06

64	1,7040E+03	1.0000E+00	0,0000E+00	1,3491E-04	4.0000E-02	1,9614E-04
65	1,7140E+03	1.0000E+00	0,0000E+00	1,3430E-04	4.0000E-02	9,2157E-06
66	1,7340E+03	1.0000E+00	0,0000E+00	1,3459E-04	4.0000E-02	9,7769E-05
67	1,7440E+03	1.0000E+00	0,0000E+00	1,3428E-04	4.0000E-02	9,3101E-06
68	1,8700E+03	1.0000E+00	0,0000E+00	1,3664E-04	4.0000E-02	7,5674E-04
69	1,8800E+03	1.0000E+00	0,0000E+00	1,3421E-04	4.0000E-02	9,7290E-06
70	1,8960E+03	1.0000E+00	0,0000E+00	1,3450E-04	4.0000E-02	9,0610E-05
71	1,9060E+03	1.0000E+00	0,0000E+00	1,3420E-04	4.0000E-02	9,8077E-06
72	1,9240E+03	1.0000E+00	0,0000E+00	1,3444E-04	4.0000E-02	8,4718E-05
73	1,9340E+03	1.0000E+00	0,0000E+00	1,3418E-04	4.0000E-02	9,8926E-06
74	1,9970E+03	1.0000E+00	0,0000E+00	1,3434E-04	4.0000E-02	7,0734E-05
75	2,0070E+03	1.0000E+00	0,0000E+00	1,3414E-04	4.0000E-02	1,0110E-05
76	2,0390E+03	1.0000E+00	0,0000E+00	1,3422E-04	4.0000E-02	3,8308E-05
77	2,1010E+03	1.0000E+00	0,0000E+00	1,3406E-04	4.0000E-02	6,7502E-06
78	2,1280E+03	1.0000E+00	0,0000E+00	1,3408E-04	4.0000E-02	1.7795E-05
79	2,1560E+03	1.0000E+00	0,0000E+00	1,3402E-04	4.0000E-02	3,6900E-06
80	2,1750E+03	1.0000E+00	0,0000E+00	1,3403E-04	4.0000E-02	1,0600E-05
81	2,1850E+03	1.0000E+00	0,0000E+00	1,3401E-04	4.0000E-02	4,7820E-06
82	2,2140E+03	1.0000E+00	0,0000E+00	1,3409E-04	4.0000E-02	3,5384E-05
83	2,2240E+03	1.0000E+00	0,0000E+00	1,3405E-04	4.0000E-02	2,3640E-05
84	2,2540E+03	1.0000E+00	0,0000E+00	1,3427E-04	4.0000E-02	9,8389E-05
85	2,2840E+03	1.0000E+00	0,0000E+00	1,3394E-04	4.0000E-02	1,0906E-06
86	2,3050E+03	1.0000E+00	0,0000E+00	1,3398E-04	4.0000E-02	1,9203E-05
87	2,3150E+03	1.0000E+00	0,0000E+00	1,3394E-04	4.0000E-02	5,4972E-06
88	2,3360E+03	1.0000E+00	0,0000E+00	1,3390E-04	4.0000E-02	1,1052E-06
89	2,3580E+03	1.0000E+00	0,0000E+00	1,3389E-04	4.0000E-02	3,3342E-06
90	2,3790E+03	1.0000E+00	0,0000E+00	1,3394E-04	4.0000E-02	2,4041E-05
91	2,4010E+03	1.0000E+00	0,0000E+00	1,3387E-04	4.0000E-02	2,2464E-06
92	2,4230E+03	1.0000E+00	0,0000E+00	1,3412E-04	4.0000E-02	8,7873E-05
93	2,4460E+03	1.0000E+00	0,0000E+00	1,3387E-04	4.0000E-02	1,3066E-05
94	2,4800E+03	1.0000E+00	0,0000E+00	1,3383E-04	4.0000E-02	6,2980E-06
95	2,5160E+03	1.0000E+00	0,0000E+00	1,3407E-04	4.0000E-02	8,3442E-05
96	2,5390E+03	1.0000E+00	0,0000E+00	1,3381E-04	4.0000E-02	1,8588E-05
97	2,5640E+03	1.0000E+00	0,0000E+00	1,3419E-04	4.0000E-02	1,3196E-04
98	2,6130E+03	1.0000E+00	0,0000E+00	1,3373E-04	4.0000E-02	7,6775E-06
99	2,6640E+03	1.0000E+00	0,0000E+00	1,3375E-04	4.0000E-02	1,6132E-05
100	2,7300E+03	1.0000E+00	0,0000E+00	1,3416E-04	4.0000E-02	1,5971E-04
101	2,7570E+03	1.0000E+00	0,0000E+00	1,3372E-04	4.0000E-02	3,2338E-05
102	2,7710E+03	1.0000E+00	0,0000E+00	1,3376E-04	4.0000E-02	5,0219E-05
103	2,8120E+03	1.0000E+00	0,0000E+00	1,3451E-04	4.0000E-02	7,9759E-06
104	2,8490E+03	1.0000E+00	0,0000E+00	1,3464E-04	4.0000E-02	4,7573E-05
105	2,8690E+03	1.0000E+00	0,0000E+00	1,3452E-04	4.0000E-02	1,6145E-05
106	2,8980E+03	1.0000E+00	0,0000E+00	1,3476E-04	4.0000E-02	8,8947E-05
107	2,9580E+03	1.0000E+00	0,0000E+00	1,3448E-04	4.0000E-02	1,2010E-05
108	3,0190E+03	1.0000E+00	0,0000E+00	1,3525E-04	4.0000E-02	2,5043E-04
109	3,0660E+03	1.0000E+00	0,0000E+00	1,3444E-04	4.0000E-02	1,2265E-05
110	3,1310E+03	1.0000E+00	0,0000E+00	1,3491E-04	4.0000E-02	1,5903E-04
111	3,1640E+03	1.0000E+00	0,0000E+00	1,3448E-04	4.0000E-02	3,4221E-05
112	3,1980E+03	1.0000E+00	0,0000E+00	1,3484E-04	4.0000E-02	1,4363E-04
113	3,2320E+03	1.0000E+00	0,0000E+00	1,3449E-04	4.0000E-02	4,2660E-05
114	3,2490E+03	1.0000E+00	0,0000E+00	1,3471E-04	4.0000E-02	1,1060E-04
115	3,3020E+03	1.0000E+00	0,0000E+00	1,3437E-04	4.0000E-02	1,4834E-05
116	3,3560E+03	1.0000E+00	0,0000E+00	1,3481E-04	4.0000E-02	1,5396E-04
117	3,3930E+03	1.0000E+00	0,0000E+00	1,3437E-04	4.0000E-02	2,4672E-05
118	3,4500E+03	1.0000E+00	0,0000E+00	1,3469E-04	4.0000E-02	1,2713E-04
119	3,4880E+03	1.0000E+00	0,0000E+00	1,3436E-04	4.0000E-02	3,2746E-05
120	3,5470E+03	1.0000E+00	0,0000E+00	1,3429E-04	4.0000E-02	1,6876E-05
121	3,6070E+03	1.0000E+00	0,0000E+00	1,3440E-04	4.0000E-02	5,5495E-05
122	3,6900E+03	1.0000E+00	0,0000E+00	1,3426E-04	4.0000E-02	2,3034E-05
123	3,7540E+03	1.0000E+00	0,0000E+00	1,3467E-04	4.0000E-02	1,5278E-04
124	3,8640E+03	1.0000E+00	0,0000E+00	1,3414E-04	4.0000E-02	8,1295E-06
125	3,9100E+03	1.0000E+00	0,0000E+00	1,3445E-04	4.0000E-02	1,0531E-04
126	4,0270E+03	1.0000E+00	0,0000E+00	1,3413E-04	4.0000E-02	2,2725E-05
127	4,0760E+03	1.0000E+00	0,0000E+00	1,3425E-04	4.0000E-02	6,4997E-05
128	4,3310E+03	1.0000E+00	0,0000E+00	1,3409E-04	4.0000E-02	4,6662E-05
129	4,3860E+03	1.0000E+00	0,0000E+00	1,3418E-04	4.0000E-02	7,9053E-05
130	4,4970E+03	1.0000E+00	0,0000E+00	1,3395E-04	4.0000E-02	2,1004E-05
131	4,6720E+03	1.0000E+00	0,0000E+00	1,3404E-04	4.0000E-02	2,1266E-04
132	4,7940E+03	1.0000E+00	0,0000E+00	1,3342E-04	4.0000E-02	2,5195E-05
133	4,9540E+03	1.0000E+00	0,0000E+00	1,3367E-04	4.0000E-02	1,0211E-04
134	4,0000E+04	1.0000E+00	0,0000E+00	1,3425E-04	4.0000E-02	2,7916E-04

REACTION Q VALUE 2.0000E+08 EV

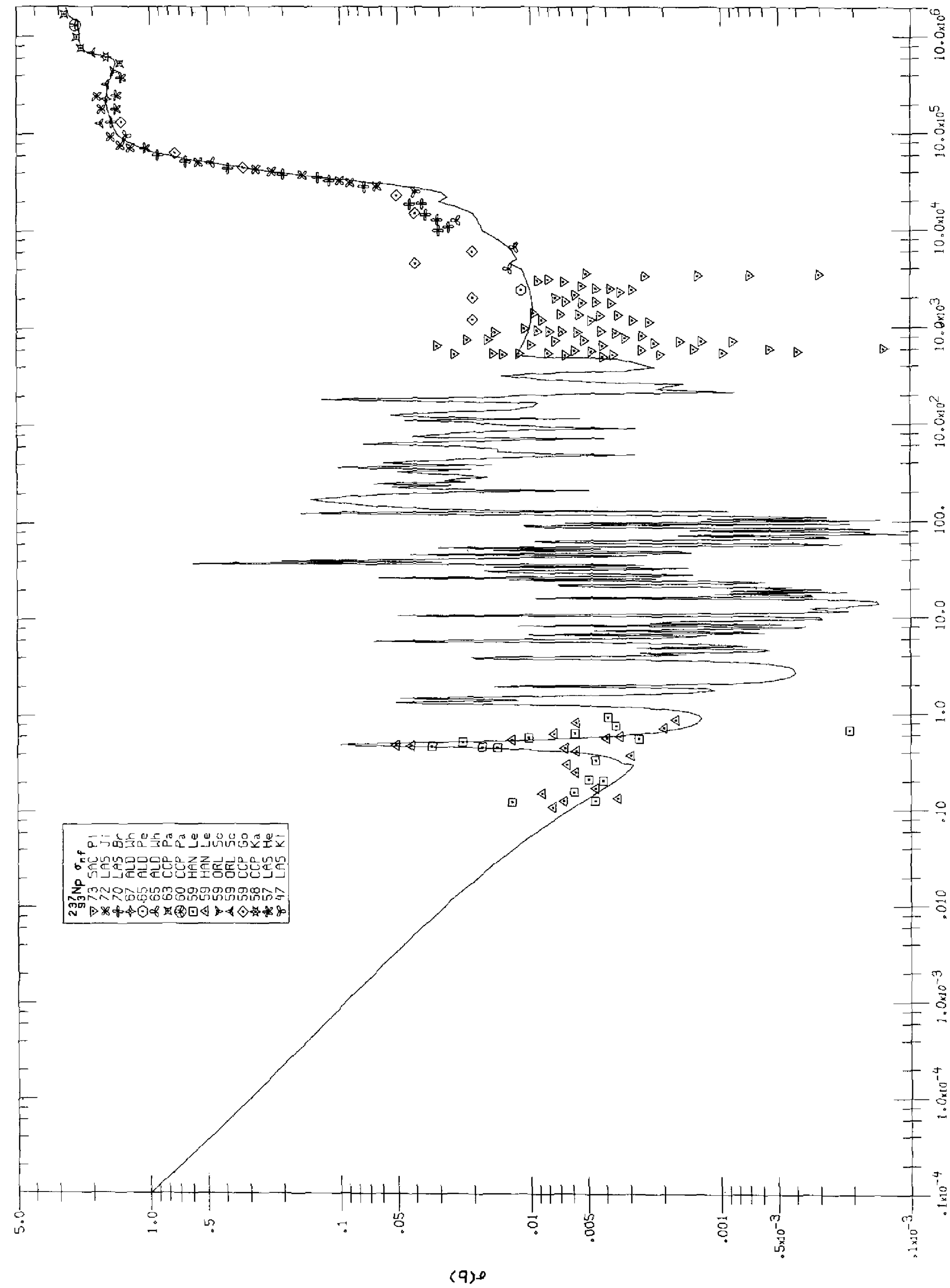
INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION	RANGE	DESCRIPTION
1 TO 154	LN Y LINEAR IN LN X	154 TO 316	Y LINEAR IN X

NEUTRON CROSS SECTIONS

INDEX,	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	1.0000E-05	1.0000E+00	1.2000E-04	2.7520E-01	1.4000E-04	2.5476E-01	1.6000E-04	2.3828E-01	1.8000E-04	2.2463E-01
6	2.0000E-04	2.1308E-01	2.2000E-04	2.0314E-01	2.4000E-04	1.9447E-01	2.5300E-04	1.8939E-01	2.6000E-04	1.8682E-01
11	2.8000E-04	1.8000E-01	3.0000E-04	1.7388E-01	3.2000E-04	1.6834E-01	3.4000E-04	1.6329E-01	3.6000E-04	1.5867E-01
16	3.8000E-04	1.5442E-01	4.0000E-04	1.5050E-01	4.2000E-04	1.4685E-01	4.4000E-04	1.4346E-01	4.6000E-04	1.4029E-01
21	4.8000E-04	1.3732E-01	5.0000E-04	1.3453E-01	5.2000E-04	1.3191E-01	5.4000E-04	1.2943E-01	5.6000E-04	1.2708E-01
26	5.8000E-04	1.2485E-01	6.0000E-04	1.2274E-01	6.2000E-04	1.2073E-01	6.4000E-04	1.1882E-01	6.6000E-04	1.1699E-01
31	6.8000E-04	1.1524E-01	7.0000E-04	1.1357E-01	7.2000E-04	1.1197E-01	7.4000E-04	1.1044E-01	7.6000E-04	1.0896E-01
36	7.8000E-04	1.0754E-01	8.0000E-04	1.0618E-01	8.2000E-04	1.0486E-01	8.4000E-04	1.0359E-01	8.6000E-04	1.0237E-01
41	8.8000E-04	1.0119E-01	9.0000E-04	1.0005E-01	9.2000E-04	9.8944E-02	9.4000E-04	9.7875E-02	9.6000E-04	9.6839E-02
46	9.8000E-04	9.5835E-02	1.0000E-03	9.4861E-02	1.2000E-03	8.6498E-02	1.4000E-03	7.9992E-02	1.6000E-03	7.4742E-02
51	1.8000E-03	7.0388E-02	2.0000E-03	6.6701E-02	2.2000E-03	6.3526E-02	2.4000E-03	6.0754E-02	2.5300E-03	5.9129E-02
56	2.6000E-03	5.8305E-02	2.8000E-03	5.6122E-02	3.0000E-03	5.4159E-02	3.2000E-03	5.2381E-02	3.4000E-03	5.0761E-02
61	3.6000E-03	4.9276E-02	3.8000E-03	4.7909E-02	4.0000E-03	4.6644E-02	4.2000E-03	4.5470E-02	4.4000E-03	4.4376E-02
66	4.6000E-03	4.3352E-02	4.8000E-03	4.2393E-02	5.0000E-03	4.1491E-02	5.2000E-03	4.0641E-02	5.3361E-03	4.0090E-02
71	5.4000E-03	3.9838E-02	5.6000E-03	3.9077E-02	5.8000E-03	3.8356E-02	6.0000E-03	3.7670E-02	6.2000E-03	3.7018E-02
76	6.4000E-03	3.6395E-02	6.6000E-03	3.5801E-02	6.8000E-03	3.5232E-02	7.0000E-03	3.4688E-02	7.2000E-03	3.4166E-02
81	7.4000E-03	3.3665E-02	7.6000E-03	3.3183E-02	7.8000E-03	3.2720E-02	8.0000E-03	3.2274E-02	8.2000E-03	3.1843E-02
86	8.4000E-03	3.1428E-02	8.6000E-03	3.1028E-02	8.8000E-03	3.0640E-02	9.0000E-03	3.0266E-02	9.2000E-03	2.9903E-02
91	9.4000E-03	2.9552E-02	9.6000E-03	2.9212E-02	9.8000E-03	2.8881E-02	1.0000E-02	2.8561E-02	1.2000E-02	2.5801E-02
96	1.4000E-02	2.3642E-02	1.6000E-02	2.1891E-02	1.8000E-02	2.0433E-02	2.0000E-02	1.9193E-02	2.2000E-02	1.8122E-02
101	2.4000E-02	1.7185E-02	2.5300E-02	1.6634E-02	2.6000E-02	1.6355E-02	2.8000E-02	1.5613E-02	3.0000E-02	1.4945E-02
106	3.2000E-02	1.4339E-02	3.4000E-02	1.3787E-02	3.6000E-02	1.3280E-02	3.8000E-02	1.2814E-02	4.0000E-02	1.2382E-02
111	4.2000E-02	1.1982E-02	4.4000E-02	1.1608E-02	4.6000E-02	1.1260E-02	4.8000E-02	1.0933E-02	5.0000E-02	1.0626E-02
116	5.2000E-02	1.0337E-02	5.4000E-02	1.0065E-02	5.6000E-02	9.8075E-03	5.8000E-02	9.5637E-03	6.0000E-02	9.3324E-03
121	6.2000E-02	9.1126E-03	6.4000E-02	8.9036E-03	6.6000E-02	8.7044E-03	6.8000E-02	8.5144E-03	7.0000E-02	8.3329E-03
126	7.2000E-02	8.1594E-03	7.4000E-02	7.9933E-03	7.6000E-02	7.8341E-03	7.8000E-02	7.6814E-03	8.0000E-02	7.5349E-03
131	8.2000E-02	7.3941E-03	8.4000E-02	7.2587E-03	8.6000E-02	7.1284E-03	8.8000E-02	7.0029E-03	9.0000E-02	6.8819E-03
136	9.0450E-02	6.8553E-03	9.2000E-02	6.7653E-03	9.4000E-02	6.6527E-03	9.6000E-02	6.5440E-03	9.8000E-02	6.4389E-03
141	1.0000E-01	6.3374E-03	1.2000E-01	5.4814E-03	1.4000E-01	4.8412E-03	1.5711E-01	4.4114E-03	1.6000E-01	4.3474E-03
146	1.8000E-01	3.9585E-03	2.0000E-01	3.6485E-03	2.2000E-01	3.4007E-03	2.4000E-01	3.2042E-03	2.4752E-01	3.1422E-03
151	2.5300E-01	3.1009E-03	2.6000E-01	3.0528E-03	2.8000E-01	2.9439E-03	3.0000E-01	2.8790E-03	3.0000E-01	0.0000E+00
156	1.0000E+04	0.0000E+00	4.0000E+04	0.0000E+00	4.0000E+04	1.1700E-02	4.0700E+04	1.2021E-02	4.5000E+04	1.2838E-02
161	4.8200E+04	1.2331E-02	5.0000E+04	1.1700E-02	5.9850E+04	1.2287E-02	6.0000E+04	1.2299E-02	6.2000E+04	1.2478E-02
166	6.5000E+04	1.2777E-02	7.0000E+04	1.3348E-02	7.6000E+04	1.4132E-02	7.6320E+04	1.4176E-02	8.0000E+04	1.4698E-02
171	8.8000E+04	1.5893E-02	9.0000E+04	1.6198E-02	1.0000E+05	1.7700E-02	1.0300E+05	1.7829E-02	1.0340E+05	1.7845E-02
176	1.0500E+05	1.7908E-02	1.1000E+05	1.8091E-02	1.3000E+05	1.8794E-02	1.5000E+05	2.0000E-02	1.5900E+05	2.1252E-02
181	1.5970E+05	2.1360E-02	1.8000E+05	2.5121E-02	2.0000E+05	3.0000E-02	2.2490E+05	2.7190E-02	2.5000E+05	2.9333E-02
186	2.6800E+05	3.4861E-02	2.6910E+05	3.5323E-02	3.0000E+05	5.5000E-02	3.0630E+05	6.1906E-02	3.3340E+05	9.5780E-02
191	3.5000E+05	1.2000E-01	3.6900E+05	1.5153E-01	3.7060E+05	1.5434E-01	3.7100E+05	1.5504E-01	3.7260E+05	1.5788E-01
196	4.0000E+05	2.1000E-01	4.5000E+05	3.2000E-01	4.7000E+05	3.7408E-01	5.0000E+05	4.6500E-01	5.5000E+05	6.4000E-01
201	5.7000E+05	7.0636E-01	6.0000E+05	8.0000E-01	6.5000E+05	9.3500E-01	7.0000E+05	1.0500E+00	7.5000E+05	1.1500E+00
206	7.7500E+05	1.1962E+00	8.0000E+05	1.2400E+00	8.5000E+05	1.3200E+00	9.0000E+05	1.3800E+00	9.5000E+05	1.4500E+00
211	1.0000E+06	1.4820E+00	1.2000E+06	1.5500E+00	1.4000E+06	1.5900E+00	1.6000E+06	1.6200E+00	1.8000E+06	1.6500E+00
216	2.0000E+06	1.6690E+00	2.2000E+06	1.6900E+00	2.4000E+06	1.6950E+00	2.6000E+06	1.7000E+00	2.8000E+06	1.6900E+00
221	3.0000E+06	1.6630E+00	3.2000E+06	1.6500E+00	3.4000E+06	1.6250E+00	3.6000E+06	1.6030E+00	3.8000E+06	1.5800E+00
226	4.0000E+06	1.5520E+00	4.2000E+06	1.5500E+00	4.4000E+06	1.5350E+00	4.6000E+06	1.5250E+00	4.8000E+06	1.5150E+00
231	5.0000E+06	1.5050E+00	5.2000E+06	1.5000E+00	5.4000E+06	1.4820E+00	5.6000E+06	1.5050E+00	5.8000E+06	1.5400E+00
236	6.0000E+06	1.6000E+00	6.2000E+06	1.6800E+00	6.4000E+06	1.8000E+00	6.6000E+06	1.9600E+00	6.7890E+06	2.0749E+00
241	6.8000E+06	2.0800E+00	6.8570E+06	2.0983E+00	6.9270E+06	2.1154E+00	7.0000E+06	2.1300E+00	7.0710E+06	2.1493E+00

246	7,1460E+06	2.1682E+00	7,2000E+06	2.1800E+00	7,3000E+06	2,1919E+00	7.4000E+06	2.2000E+00	7,6000E+06	2,2200E+00
251	7,7000E+06	2,2250E+00	7,8000E+06	2,2300E+00	7,9000E+06	2,2400E+00	8,0000E+06	2.2500E+00	8,2000E+06	2.2600E+00
256	8,4000E+06	2,2800E+00	8,6000E+06	2,3000E+00	8,8000E+06	2,3100E+00	9,0000E+06	2.3200E+00	9,2000E+06	2,3300E+00
261	9,4000E+06	2.3350E+00	9.6000E+06	2,3400E+00	9,8000E+06	2,3450E+00	1,0000E+07	2.3500E+00	1,0200E+07	2,3550E+00
266	1,0400E+07	2,3550E+00	1,0600E+07	2,3500E+00	1,0800E+07	2,3450E+00	1,1000E+07	2.3400E+00	1,1200E+07	2,3350E+00
271	1,1400E+07	2,3300E+00	1,1600E+07	2,3200E+00	1,1800E+07	2,3100E+00	1,2000E+07	2.3000E+00	1,2200E+07	2,3000E+00
276	1,2340E+07	2.3000E+00	1,2400E+07	2,3000E+00	1,2570E+07	2,2998E+00	1,2600E+07	2.3000E+00	1,2800E+07	2,3050E+00
281	1,3000E+07	2.3050E+00	1,3200E+07	2,3100E+00	1,3400E+07	2,3150E+00	1.3600E+07	2.3200E+00	1,3800E+07	2,3300E+00
286	1,4000E+07	2,3370E+00	1,4200E+07	2,3700E+00	1,4400E+07	2,4000E+00	1,4600E+07	2.4200E+00	1,4800E+07	2,4500E+00
291	1,5000E+07	2.4800E+00	1,5200E+07	2,5200E+00	1,5400E+07	2,5450E+00	1.5600E+07	2.5800E+00	1,5800E+07	2,6000E+00
296	1,6000E+07	2,6200E+00	1,6200E+07	2,6500E+00	1,6400E+07	2,6700E+00	1,6600E+07	2,6800E+00	1,6800E+07	2,6800E+00
301	1,7000E+07	2,6800E+00	1,7200E+07	2,6800E+00	1,7400E+07	2,6800E+00	1,7600E+07	2,6800E+00	1,7800E+07	2,6800E+00
306	1,8000E+07	2,6800E+00	1,8200E+07	2,6850E+00	1,8400E+07	2,6950E+00	1,8600E+07	2,7000E+00	1,8800E+07	2,7000E+00
311	1,9000E+07	2,7000E+00	1,9200E+07	2,7100E+00	1,9400E+07	2,7200E+00	1,9600E+07	2,7250E+00	1,9800E+07	2,7300E+00
316	2,0000E+07	2,7350E+00								


σ(b)
En(eV)

REFERENCES FOR EXPERIMENTAL DATA

$^{237}Np(n,f)$

Yr.	Lab	Author	References
73	SAC	Plattard, et al.	Priv. Comm. (1973)
72	LAS	Jiacoletti, et al.	Nuc. Sci.&Eng. 48, 412 (1972)
70	LAS	Brown, et al.	Nuc. Phys./A 156, 609 (1970)
67	ALD	White, et al.	J. Nuc. En. 21, 67 (1967)
65	ALD	Perkin, et al.	J. Nuc. En. 19, 423 (1965)
65	ALD	White, et al.	Phys. & Chem. of Fisson Conf. Salzburg, Vol I, 219 (1965)
63	CCP	Pankratov	At. En. 14, 177 (1963)
60	CCP	Pankratov, et al.	At. En. 9, 399 (1960)
59	HAN	Leonard, et al.	Bull. Am. Phys. Soc. 4, 31 (1959)
59	ORL	Schmitt, et al.	Phys. Rev. 116, 1575 (1959)
59	CCP	Gokhberg	Dok. 128, 1157 (1959)
58	CCP	Kalanin	Second Peaceful Uses of At. En. Conf. Geneva Vol 16, 136 (1958)
57	LAS	Henkel	LA-2122 (1957)
47	LAS	Klema	Phys. Rev. 72, 88 (1947)

94-PU-239 GE-BRO,LAS EVAL-MAR74 B.A.HUTCHINS, R.HUNTER, L.STEWART
DIST-1974 REV-OCT74
P.C. TO NORMALIZATION AND STANDARDS SUBCOMMITTEE MARCH 1974
PERTINENT HOLLORITH FROM GENERAL FILE FOLLOWS (MAT 1264)
ALL REFERENCES CARRIED OVER FROM GENERAL FILE

PRINCIPAL EVALUATORS = B.A. HUTCHINS (GE-BRO),R.HUNTER(LASL),
L.STEWART(LASL),R.LABAUVE(LASL).

CONTRIBUTING EVALUATORS

NU-BAR--B.R.LEONARD,JR.(BNW LAB), THERMAL DATA TASK FORCE
F.P.YIELDS--R. SCHENTER (HEDL), FIS AND DECAY PROD TASK FORCE
DELAYED NEUTRONS--H. HUMMEL (ANL), COX (ANL)
RADIOACTIVE DECAY--C.W.REICH (ANC)
RESOLVED RES.--J.R. SMITH (ANC), R. GWIN (ORNL), R. KINSEY (BNL

SMOOTH DATA

THERMAL RANGE--B. R. LEONARD(BNW LAB), THERMAL DATA TASK FORCE
1 EV - 1 MEV --F. SCHMITTROTH(HEDL), T.A.PITTERLE(WARD)
G. DESAUSSURE (ORNL), W. POENITZ (ANL)
1 MEV- 20 MEV--L. STEWART (LASL), R. HUNTER(LASL)
INELASTIC SCAT--L.STEWART, R. HUNTER (LASL)
SEC NEUT DISTRIBUTIONS-- L. STEWART, R.HUNTER (LASL)
GAMMA-PROD-- R. HUNTER AND L. STEWART (LASL)

EVALUATIONS ARE DESCRIBED AND REFERENCED IN ENDF-199 (REF. 1)

MF = 2

RESOLVED RES.
PRIMARY DATA SOURCES ARE GWIN(7) FOR FISSION AND CAPTURE
AND DERRIEN(8) FOR TOTAL. PARAMETERS (SLBW) GENERATED BY
SMITH, KINSEY AND GARBER. ENERGY RANGE 1 EV TO 301 EV.

UNRESOLVED RES.
PRIMARY DATA SOURCES ARE GWIN(9) AND WESTON (10). ENERGY-
DEPENDENT SLBW PARAMETERS PROVIDE SECONDARY STRUCTURE
IN FISSION, CAPTURE AND TOTAL CROSS SECTIONS. ENERGY RANGE
301 EV TO 25 KEV. INTERPOLATION SHOULD BE ON CROSS SECTIONS.

MF = 3

SMOOTH DATA
THERMAL DATA--ENERGY DEPENDENCE SAME AS VERSION III.
RENORMALIZATION OF FISSION AND CAPTURE TO 2200 M/SEC
VALUES OF 741.7 AND 270.2 FROM 1973 LSQ ANALYSIS OF
THERMAL DATA TASK FORCE(6).

1 EV TO 25 KEV--SMOOTH CONTRIBUTIONS IN THE RESOLVED RANGE
CHOSEN TO MAKE COMBINED RESONANCE AND SMOOTH FISSION AND
CAPTURE CROSS SECTIONS CONSISTENT WITH GWIN(7) MEASUREMENTS,
AND TOTAL WITH DERRIEN VALUES(8),
SMOOTH DATA IN UNRESOLVED ONLY FOR INELASTIC SCATTERING
AND MINOR ADJUSTMENTS AT RANGE BOUNDARIES,

25 KEV TO 1 MEV--TOTAL BASED ON MEASUREMENTS OF SMITH(11)
AND HEATON(12), FISSION PRIMARILY BASED ON GWIN DATA(9) AND
THAT OF PFLETSCHINGER(13), CAPTURE OBTAINED FROM ALPHA
MEASUREMENTS OF GWIN(9), WESTON(10) AND HOPKINS(14),
INELASTIC LEVELS ADJUSTED FOR LOW LYING LEVELS TO PARTIALLY
COMPENSATE FOR INCLUSION IN THE ELASTIC CHANNEL,
ELASTIC DETERMINED FROM BALANCE OF TOTAL,

1 MEV TO 20 MEV--DATA BASED ON EVALUATION OF HUNTER(2),
WITH FOLLOWING ADJUSTMENTS -1)FISSION TO CONFORM TO
ENDF/B-IV U=235 FISSION AND INTEGRAL MEASUREMENTS 2)TOTAL
TO AGREE BETTER WITH HEATON (12) 3)ELASTIC FOR BALANCE AND
AGREE WITH UNITARITY, FIRST, SECOND, THIRD AND FOURTH
CHANCE FISSION INCLUDED, WITH MT=18 BEING THE SUM,

REFERENCES

1) PU-239 DATA EVALUATIONS FOR ENDF/B-IV, ENDF-199(TO BE ISSUED),
2) HUNTER, STEWART, HIRONS, LA-5172 (JUNE, 1973),
3) SOLEILAC, FREHAUT, GAURIAU, J. NUCL. ENG, 23 (1969),
4) FISSION PRODUCT DATA FOR ENDF/B-IV, R.E. SCHENTER (TO BE PUBLISHED),
5) DELAYED NEUTRON DATA FOR ENDF/B-IV, S, COX (TO BE PUBLISHED),
6) THERMAL NEUTRON DATA FOR ENDF/B-IV, J. STEHN (TO BE PUBLISHED),
7) GWIN, PRIVATE COMMUNICATION (1973),
8) DERRIEN, CN26/61, HELSINKI (1970),
9) GWIN, SILVER, INGLE, TRANS, AM, NUC, SOC, 15, 481 (1972),
10)WESTON, TODD, TRANS, AM, NUC, SOC,, 480 (1972),
11)SMITH, GUENTHER, WHALEN (1972),
12)HEATON, SCHWARTZ (1972),
13)PFLETSCHINGER, KAPPELER, NUC, SCI, AND ENG,. 40 (1970),
14)HOPKINS, DIVEN, NUC, SCI, AND ENG, 12, 169 (1962),
15)COPPOLA, KNITTER, Z,PHYS, 232, 286 (1970) - 228,286 (1969),
16)KAMMERDIEMER, UCRL-51232 (1972),
17)BARNARD, FERGUSON, MCMURRAY, VAN HEERDEN, NUCL, PHYS, 71 (1965)
18)ZAMYATNIN, SAFINA, GUTNIKOVA, IVANNOVA, ATOMNAYA ENER, 4 (1958)
19)HUNTER, STEWART, LA-4901 (1972),
20)DRAKE, HOPKINS, YOUNG, CONDE, NUC, SCI, ENG, 40, (1970),
21)NELLIS, MORGAN, ORO-2791-17 (1966),

PLUTONIUM-239

ENDF/B MATERIAL NO. 6264

TABLE OF CONTENTS

GENERAL INFORMATION

DATA TYPE	REACTION	CARDS
GENERAL INFORMATION	COMMENTS	100
	TABLE OF CONTENTS	3
RESONANCE PARAMETERS	RESONANCE DATA	617
NEUTRON CROSS SECTION	FISSION	160

PLUTONIUM-239

ENDF/B MATERIAL NO. 6264

RESONANCE DATA

RESONANCE PARAMETERS

ISOTOPE---------------------PLUTONIUM-239
FRACTIONAL ABUNDANCE---------- 1.0000E+00
NUMBER OF ENERGY RANGES------- 2

ENERGY RANGE NUMBER----------- 1 RESOLVED SINGLE-LEVEL BREIT-WIGNER PARAMETERS
LOWER ENERGY LIMIT (EV)------- 1.0000E+00
UPPER ENERGY LIMIT (EV)------- 3.0100E+02
NUCLEAR SPIN------------------ 5.0000E-01
SPIN SCATTERING LENGTH (A+)--- 9.0094E-01
NUMBER OF L STATES------------ 1

L VALUE----------------------- 0
NUMBER OF RESONANCES---------- 128
SPIN SCATTERING LENGTH (A-)--- 0.0000E+00

				RESONANCE WIDTHS (EV)		
INDEX	ENERGY (EV)	J VALUE	TOTAL	NEUTRON	RADIATION	FISSION
1	-2.2000E-01	0.0000E+00	5.4005E-01	4.7000E-05	4.0000E-02	5.0000E-01
2	2.9600E-01	0.0000E+00	9.9242E-02	2.4200E-04	3.9000E-02	4.0000E-02
3	7.8130E+00	1.0000E+00	8.6819E-02	8.1900E-04	4.0155E-02	4.5845E-02
4	1.0941E+01	1.0000E+00	1.9917E-01	1.8660E-03	4.4225E-02	1.5308E-01
5	1.1890E+01	1.0000E+00	6.6014E-02	1.0140E-03	4.0632E-02	2.4368E-02
6	1.4310E+01	1.0000E+00	1.0160E-01	5.9900E-04	3.5919E-02	6.5081E-02
7	1.4685E+01	1.0000E+00	6.8790E-02	1.7900E-03	3.6840E-02	3.0160E-02
8	1.5470E+01	0.0000E+00	7.2443E-01	2.1200E-03	3.9000E-02	6.8331E-01
9	1.7650E+01	1.0000E+00	7.3692E-02	1.6920E-03	3.8479E-02	3.3521E-02
10	2.2266E+01	1.0000E+00	1.1862E-01	2.6160E-03	4.6580E-02	6.9420E-02
11	2.3905E+01	0.0000E+00	7.0272E-02	2.7200E-04	3.7367E-02	3.2633E-02
12	2.6252E+01	1.0000E+00	8.2513E-02	1.5130E-03	3.9679E-02	4.1321E-02
13	2.7260E+01	0.0000E+00	4.3666E-02	4.1800E-04	3.9000E-02	4.2480E-03
14	3.2328E+01	0.0000E+00	1.6682E-01	8.1600E-04	4.8185E-02	1.1781E-01
15	3.5460E+01	1.0000E+00	4.7241E-02	2.4100E-04	4.2448E-02	4.5520E-03
16	4.1430E+01	1.0000E+00	4.9747E-02	3.7470E-03	4.2028E-02	3.9720E-03
17	4.1685E+01	1.0000E+00	1.0545E-01	1.4520E-03	5.9392E-02	4.4608E-02
18	4.4500E+01	1.0000E+00	4.8848E-02	5.9480E-03	3.8763E-02	4.1370E-03
19	4.7640E+01	0.0000E+00	2.6386E-01	4.8560E-03	5.0415E-02	2.0859E-01
20	4.9700E+01	0.0000E+00	8.1161E-01	3.8070E-03	6.1800E-02	7.4600E-01
21	5.0113E+01	1.0000E+00	5.7427E-02	2.9270E-03	4.1479E-02	1.3021E-02
22	5.2620E+01	1.0000E+00	6.2058E-02	9.6580E-03	4.3963E-02	8.4370E-03
23	5.5660E+01	1.0000E+00	5.6850E-02	1.3500E-03	3.7342E-02	1.8158E-02
24	5.7550E+01	0.0000E+00	6.3556E-01	1.0562E-02	4.5000E-02	5.8000E-01
25	5.7900E+01	0.0000E+00	9.9816E-01	9.1580E-03	3.9000E-02	9.5000E-01
26	5.9254E+01	1.0000E+00	1.4351E-01	4.5070E-03	3.8103E-02	1.0090E-01
27	6.0970E+01	0.0000E+00	6.8132E+00	2.4268E-02	5.2999E-02	6.7360E+00
28	6.3110E+01	1.0000E+00	1.5270E-01	6.9800E-04	5.5201E-02	9.6799E-02
29	6.5550E+01	0.0000E+00	1.3397E-01	3.9710E-03	3.0000E-02	1.0000E-01
30	6.5790E+01	1.0000E+00	1.2639E-01	1.1192E-02	6.0313E-02	5.4887E-02
31	7.4087E+01	1.0000E+00	7.3291E-02	3.2910E-03	3.8296E-02	3.1704E-02
32	7.4950E+01	1.0000E+00	1.4513E-01	2.0126E-02	3.7654E-02	8.7346E-02
33	8.1600E+01	0.0000E+00	9.3746E-01	3.7600E-03	3.9000E-02	8.9469E-01
34	8.2650E+01	0.0000E+00	1.2428E+00	3.7960E-03	3.9000E-02	1.2000E+00
35	8.2710E+01	0.0000E+00	3.9929E-02	9.2900E-04	3.9000E-02	0.0000E+00
36	8.5270E+01	0.0000E+00	2.3542E+00	5.0182E-02	3.9000E-02	2.2650E+00
37	8.5535E+01	1.0000E+00	5.9523E-02	7.5230E-03	3.9863E-02	1.2137E-02
38	9.0770E+01	1.0000E+00	5.7998E-02	1.1298E-02	3.8110E-02	8.5900E-03
39	9.2980E+01	1.0000E+00	5.8278E-02	7.7800E-04	4.9704E-02	7.7960E-03
40	9.5430E+01	1.0000E+00	5.0485E-02	1.9850E-03	3.3916E-02	1.4584E-02
41	9.6491E+01	0.0000E+00	1.7009E+00	1.3936E-02	4.2000E-02	1.6450E+00
42	1.0025E+02	0.0000E+00	6.0025E+00	1.3491E-02	4.2000E-02	5.9470E+00
43	1.0305E+02	1.0000E+00	4.7634E-02	1.6340E-03	3.5868E-02	1.0132E-02
44	1.0535E+02	1.0000E+00	4.5803E-02	4.8030E-03	3.6299E-02	4.7010E-03
45	1.0674E+02	1.0000E+00	6.7854E-02	9.3540E-03	3.6414E-02	2.2086E-02
46	1.1044E+02	0.0000E+00	4.4423E-02	1.4230E-03	3.0763E-02	1.2237E-02
47	1.1455E+02	0.0000E+00	1.1401E+00	1.1080E-03	3.9001E-02	1.1000E+00

48	1,1525E+02	0,0000E+00	6,9644E-02	6,4400E-04	3,9000E-02	3,0000E-02
49	1,1613E+02	0,0000E+00	2,5342E-01	1,1421E-02	5,0972E-02	1,9103E-01
50	1,1886E+02	1,0000E+00	8,5354E-02	1,7354E-02	3,4843E-02	3,3157E-02
51	1,2103E+02	0,0000E+00	8,7584E-02	7,5840E-03	3,8912E-02	4,1088E-02
52	1,2349E+02	0,0000E+00	6,4389E-02	1,3890E-03	2,4000E-02	3,9000E-02
53	1,2627E+02	0,0000E+00	5,2178E-02	5,3780E-03	3,5325E-02	1,1475E-02
54	1,2760E+02	0,0000E+00	5,3921E-02	1,9210E-03	3,2422E-02	1,9578E-02
55	1,3195E+02	0,0000E+00	3,8143E+00	3,5598E-02	3,8698E-02	3,7400E+00
56	1,3380E+02	1,0000E+00	5,4569E-02	6,5690E-03	4,3630E-02	4,3700E-03
57	1,3680E+02	0,0000E+00	1,3309E-01	1,2087E-02	4,1669E-02	7,9331E-02
58	1,3935E+02	0,0000E+00	3,9296E-02	2,9600E-04	3,9000E-02	0,0000E+00
59	1,4300E+02	1,0000E+00	1,4353E-01	3,5310E-03	5,6949E-02	8,3051E-02
60	1,4352E+02	1,0000E+00	6,9547E-02	3,5470E-03	3,4800E-02	3,1200E-02
61	1,4631E+02	1,0000E+00	6,6838E-02	8,2380E-03	4,8982E-02	9,6180E-03
62	1,4730E+02	0,0000E+00	1,0469E+00	2,8610E-03	4,4000E-02	1,0000E+00
63	1,4827E+02	0,0000E+00	1,5091E-01	1,9110E-03	5,9037E-02	8,9963E-02
64	1,4949E+02	0,0000E+00	1,1179E-01	5,7920E-03	5,8528E-02	4,7472E-02
65	1,5696E+02	0,0000E+00	4,3085E-02	4,0850E-03	3,9000E-02	0,0000E+00
66	1,5709E+02	0,0000E+00	6,1657E-01	2,8574E-02	4,8000E-02	5,4000E-01
67	1,6452E+02	1,0000E+00	7,4560E-02	2,8660E-02	3,8764E-02	7,1360E-03
68	1,6712E+02	1,0000E+00	9,8548E-02	6,5480E-03	3,8172E-02	5,3828E-02
69	1,7000E+02	0,0000E+00	4,9726E-02	7,2600E-04	3,5382E-02	1,3618E-02
70	1,7045E+02	0,0000E+00	1,8141E-01	2,4070E-03	6,0000E-02	1,1900E-01
71	1,7130E+02	0,0000E+00	1,0016E+00	1,5950E-03	4,4000E-02	9,5600E-01
72	1,7456E+02	0,0000E+00	2,4162E-01	1,1900E-04	4,1500E-02	2,0000E-01
73	1,7596E+02	1,0000E+00	7,2129E-02	2,1290E-03	4,0743E-02	2,9257E-02
74	1,7722E+02	1,0000E+00	4,9810E-02	3,8100E-03	3,9129E-02	6,8710E-03
75	1,7890E+02	1,0000E+00	5,8371E-02	1,3710E-03	4,2238E-02	1,4762E-02
76	1,8360E+02	1,0000E+00	5,5801E-02	1,8010E-03	3,3653E-02	2,0347E-02
77	1,8501E+02	0,0000E+00	1,8361E+00	1,5937E-02	3,9000E-02	1,7812E+00
78	1,8575E+02	0,0000E+00	3,9756E-02	7,5600E-04	3,9000E-02	0,0000E+00
79	1,8825E+02	0,0000E+00	5,0895E-02	1,8950E-03	3,6366E-02	1,2634E-02
80	1,9064E+02	0,0000E+00	6,6703E-02	4,7030E-03	4,7590E-02	1,4410E-02
81	1,9535E+02	0,0000E+00	5,1129E-01	5,9526E-02	5,0430E-02	4,0134E-01
82	1,9669E+02	1,0000E+00	1,1197E-01	4,9680E-03	6,0531E-02	4,6469E-02
83	1,9940E+02	1,0000E+00	1,3608E-01	1,0181E-02	4,8606E-02	7,7294E-02
84	2,0330E+02	1,0000E+00	7,0953E-02	1,9530E-03	3,9000E-02	3,0000E-02
85	2,0362E+02	1,0000E+00	8,2925E-02	2,9250E-03	2,8392E-02	5,1608E-02
86	2,0395E+02	0,0000E+00	2,9872E-01	5,3723E-02	2,6577E-02	2,1842E-01
87	2,0423E+02	0,0000E+00	1,9139E-01	1,3920E-03	3,0000E-02	1,6000E-01
88	2,0736E+02	1,0000E+00	5,6841E-02	6,8410E-03	4,2941E-02	7,0590E-03
89	2,1110E+02	0,0000E+00	1,1808E+00	4,0730E-03	3,9001E-02	1,1377E+00
90	2,1202E+02	0,0000E+00	1,5003E+00	2,3220E-03	4,2000E-02	1,4560E+00
91	2,1328E+02	0,0000E+00	1,6795E-01	1,6520E-03	3,8395E-02	1,2790E-01
92	2,1652E+02	1,0000E+00	6,3663E-02	6,6630E-03	4,7597E-02	9,4030E-03
93	2,1949E+02	1,0000E+00	6,8068E-02	3,4680E-03	4,0485E-02	2,4115E-02
94	2,2023E+02	1,0000E+00	5,0608E-02	7,9080E-03	3,1694E-02	1,1006E-02
95	2,2316E+02	1,0000E+00	5,9402E-02	3,9020E-03	4,9491E-02	6,0090E-03
96	2,2489E+02	1,0000E+00	8,5501E-02	1,8010E-03	7,0282E-02	1,3418E-02
97	2,2777E+02	0,0000E+00	8,0941E+00	2,8604E-02	4,1500E-02	8,0240E+00
98	2,2789E+02	1,0000E+00	6,5416E-02	1,9160E-03	4,1033E-02	2,2467E-02
99	2,3140E+02	1,0000E+00	5,3765E-02	1,1765E-02	3,7000E-02	5,0000E-03
100	2,3263E+02	0,0000E+00	1,0043E-01	1,4340E-03	3,9000E-02	6,0000E-02
101	2,3430E+02	1,0000E+00	6,0560E-02	9,6600E-03	3,9179E-02	1,1721E-02
102	2,3906E+02	1,0000E+00	7,0919E-02	6,0190E-03	4,8445E-02	1,6455E-02
103	2,4060E+02	0,0000E+00	2,4160E-01	9,9000E-05	4,1500E-02	2,0000E-01
104	2,4287E+02	1,0000E+00	9,4225E-02	7,1250E-03	3,4792E-02	5,2308E-02
105	2,4750E+02	0,0000E+00	9,1685E-02	2,6850E-03	2,6009E-02	6,2991E-02
106	2,4887E+02	1,0000E+00	5,5344E-02	1,6244E-02	3,3894E-02	5,2060E-03
107	2,5120E+02	1,0000E+00	8,1663E-02	4,0863E-02	3,3055E-02	7,7450E-03
108	2,5457E+02	1,0000E+00	5,8322E-02	3,4220E-03	3,1174E-02	2,3726E-02
109	2,5607E+02	1,0000E+00	8,8555E-02	7,0550E-03	5,5751E-02	2,5749E-02
110	2,5900E+02	0,0000E+00	4,0148E+00	1,1396E-02	3,9000E-02	3,9644E+00
111	2,5905E+02	0,0000E+00	3,9451E-02	4,5100E-04	3,9000E-02	0,0000E+00
112	2,6030E+02	0,0000E+00	3,9921E-02	9,2100E-04	3,9000E-02	0,0000E+00
113	2,6270E+02	0,0000E+00	4,6095E+00	7,0502E-02	3,9000E-02	4,5000E+00
114	2,6270E+02	1,0000E+00	4,9295E-02	3,2950E-03	3,6814E-02	9,1860E-03
115	2,6420E+02	0,0000E+00	4,5820E-02	1,8200E-03	2,7805E-02	1,6195E-02
116	2,6910E+02	0,0000E+00	1,3420E-01	4,1990E-03	5,5000E-02	7,5000E-02
117	2,6949E+02	1,0000E+00	6,6890E-02	4,8900E-03	3,2108E-02	2,9892E-02
118	2,7262E+02	1,0000E+00	8,9223E-02	2,5223E-02	3,3582E-02	3,0418E-02
119	2,7480E+02	1,0000E+00	7,1484E-01	8,8410E-03	5,6000E-02	6,5000E-01
120	2,7557E+02	1,0000E+00	1,5118E-01	2,5178E-02	4,6734E-02	7,9266E-02
121	2,7723E+02	0,0000E+00	5,2998E+00	1,7846E-02	4,2000E-02	5,2400E+00
122	2,7955E+02	0,0000E+00	1,2783E-01	2,7332E-02	4,9316E-02	5,1184E-02
123	2,8292E+02	1,0000E+00	7,9690E-02	1,9690E-02	4,7342E-02	1,2658E-02
124	2,8573E+02	0,0000E+00	3,4095E-01	9,4500E-04	4,0000E-02	3,0000E-01
125	2,8800E+02	0,0000E+00	7,0197E+00	3,0754E-02	3,9000E-02	6,9500E+00
126	2,9233E+02	0,0000E+00	1,1649E-01	1,3488E-02	4,8489E-02	5,4511E-02
127	2,9646E+02	1,0000E+00	8,1747E-02	3,7470E-03	5,2749E-02	2,5251E-02
128	2,9860E+02	1,0000E+00	6,8367E-02	1,0567E-02	3,7164E-02	2,0636E-02

ENDF/B MATERIAL NO. 6264

PLUTONIUM-239

RESONANCE DATA
RESONANCE PARAMETERS

ISOTOPE------------------------PLUTONIUM-239
FRACTIONAL ABUNDANCE---------- 1.0000E+00
NUMBER OF ENERGY RANGES------ 2

ENERGY RANGE NUMBER---------- 2 UNRESOLVED SINGLE-LEVEL BREIT-WIGNER PARAMETERS
LOWER ENERGY LIMIT (EV)------ 3.0100E+02
UPPER ENERGY LIMIT (EV)------ 2.5000E+04
NUCLEAR SPIN----------------- 5.0000E-01
EFFECTIVE SCATTERING RADIUS-- 9.0535E-01
NUMBER OF L STATES----------- 2

L VALUE---------------------- 0
NUMBER OF J STATES----------- 2

	DEGREES OF FREEDOM USED IN THE WIDTH DISTRIBUTION			
J-VALUE	COMPETITIVE	NEUTRON	RADIATION	FISSION
0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	2.0000E+00

			AVERAGE RESONANCE WIDTHS (EV)			
INDEX	ENERGY (EV)	LEVEL SPACING	COMPETITIVE	NEUTRON	RADIATION	FISSION
1	3.0100E+02	8.7800E+00	0.0000E+00	1.2730E-03	4.1600E-02	2.8000E+00
2	3.2000E+02	8.7800E+00	0.0000E+00	4.8174E-04	4.1600E-02	2.8000E+00
3	3.4000E+02	8.7800E+00	0.0000E+00	3.9544E-04	4.1600E-02	2.8000E+00
4	3.6000E+02	8.7800E+00	0.0000E+00	3.0799E-04	4.1600E-02	2.8000E+00
5	3.8000E+02	8.7800E+00	0.0000E+00	5.1612E-04	4.1600E-02	2.8000E+00
6	4.0400E+02	8.7800E+00	0.0000E+00	6.6419E-04	4.1600E-02	2.8000E+00
7	4.3000E+02	8.7800E+00	0.0000E+00	2.8519E-04	4.1600E-02	2.8000E+00
8	4.6000E+02	8.7800E+00	0.0000E+00	2.8607E-04	4.1600E-02	2.8000E+00
9	4.9200E+02	8.7800E+00	0.0000E+00	6.6726E-04	4.1600E-02	2.8000E+00
10	4.9500E+02	8.7800E+00	0.0000E+00	3.8876E-04	4.1600E-02	2.8000E+00
11	4.9800E+02	8.7800E+00	0.0000E+00	5.0314E-04	4.1600E-02	2.8000E+00
12	5.0100E+02	8.7800E+00	0.0000E+00	6.2863E-04	4.1600E-02	2.8000E+00
13	5.0400E+02	8.7800E+00	0.0000E+00	1.7592E-03	4.1600E-02	2.8000E+00
14	5.4600E+02	8.7800E+00	0.0000E+00	2.0613E-03	4.1600E-02	2.8000E+00
15	5.5500E+02	8.7800E+00	0.0000E+00	1.7891E-03	4.1600E-02	2.8000E+00
16	5.9500E+02	8.7800E+00	0.0000E+00	1.9010E-03	4.1600E-02	2.8000E+00
17	6.0000E+02	8.7800E+00	0.0000E+00	9.4918E-04	4.1600E-02	2.8000E+00
18	6.4000E+02	8.7800E+00	0.0000E+00	7.4047E-04	4.1600E-02	2.8000E+00
19	7.2500E+02	8.7800E+00	0.0000E+00	5.7978E-04	4.1600E-02	2.8000E+00
20	7.7500E+02	8.7800E+00	0.0000E+00	9.3243E-04	4.1600E-02	2.8000E+00
21	8.0000E+02	8.7800E+00	0.0000E+00	3.4304E-04	4.1600E-02	2.8000E+00
22	8.2500E+02	8.7800E+00	0.0000E+00	6.5279E-04	4.1600E-02	2.8000E+00
23	8.5000E+02	8.7800E+00	0.0000E+00	2.8615E-04	4.1600E-02	2.8000E+00
24	8.6000E+02	8.7800E+00	0.0000E+00	2.8814E-04	4.1600E-02	2.8000E+00
25	8.7000E+02	8.7800E+00	0.0000E+00	2.9007E-04	4.1600E-02	2.8000E+00
26	8.7500E+02	8.7800E+00	0.0000E+00	6.6652E-04	4.1600E-02	2.8000E+00
27	9.2500E+02	8.7800E+00	0.0000E+00	8.7394E-04	4.1600E-02	2.8000E+00
28	9.7500E+02	8.7800E+00	0.0000E+00	1.5840E-03	4.1600E-02	2.8000E+00
29	1.0400E+03	8.7800E+00	0.0000E+00	9.2072E-04	4.1600E-02	2.8000E+00
30	1.1600E+03	8.7800E+00	0.0000E+00	9.3660E-04	4.1600E-02	2.8000E+00
31	1.2500E+03	8.7800E+00	0.0000E+00	8.2524E-04	4.1600E-02	2.8000E+00
32	1.2600E+03	8.7800E+00	0.0000E+00	3.6441E-04	4.1600E-02	2.8000E+00
33	1.2700E+03	8.7800E+00	0.0000E+00	3.6465E-04	4.1600E-02	2.8000E+00

34	1,2800E+03	8,7800E+00	0,0000E+00	3,6474E-04	4,1600E-02	2,8000E+00
35	1,2900E+03	8,7800E+00	0,0000E+00	3,6468E-04	4,1600E-02	2,8000E+00
36	1,3000E+03	8,7800E+00	0,0000E+00	3,6449E-04	4,1600E-02	2,8000E+00
37	1,3100E+03	8,7800E+00	0,0000E+00	3,6417E-04	4,1600E-02	2,8000E+00
38	1,3200E+03	8,7800E+00	0,0000E+00	3,6373E-04	4,1600E-02	2,8000E+00
39	1,3300E+03	8,7800E+00	0,0000E+00	3,6317E-04	4,1600E-02	2,8000E+00
40	1,3400E+03	8,7800E+00	0,0000E+00	3,6249E-04	4,1600E-02	2,8000E+00
41	1,3500E+03	8,7800E+00	0,0000E+00	8,4465E-04	4,1600E-02	2,8000E+00
42	1,3700E+03	8,7800E+00	0,0000E+00	3,5567E-04	4.1600E-02	2,8000E+00
43	1,3900E+03	8,7800E+00	0,0000E+00	3,4931E-04	4.1600E-02	2,8000E+00
44	1,4100E+03	8,7800E+00	0,0000E+00	3,4259E-04	4,1600E-02	2,8000E+00
45	1,4300E+03	8,7800E+00	0,0000E+00	3,3549E-04	4,1600E-02	2,8000E+00
46	1,4500E+03	8.7800E+00	0,0000E+00	3,2797E-04	4.1600E-02	2,8000E+00
47	1,4700E+03	8.7800E+00	0,0000E+00	3,2001E-04	4.1600E-02	2,8000E+00
48	1,4900E+03	8.7800E+00	0,0000E+00	3,1157E-04	4.1600E-02	2,8000E+00
49	1,5100E+03	8.7800E+00	0,0000E+00	3,0260E-04	4.1600E-02	2,8000E+00
50	1,5300E+03	8.7800E+00	0.0000E+00	2,9306E-04	4.1600E-02	2,8000E+00
51	1,5400E+03	8.7800E+00	0.0000E+00	2,8805E-04	4.1600E-02	2,8000E+00
52	1,5500E+03	8.7800E+00	0,0000E+00	6,3740E-04	4.1600E-02	2,8000E+00
53	1,7000E+03	8.7800E+00	0,0000E+00	9,4651E-04	4.1600E-02	2,8000E+00
54	1,8000E+03	8.7800E+00	0,0000E+00	9,7678E-04	4.1600E-02	2,8000E+00
55	1,8500E+03	8.7800E+00	0,0000E+00	1,0695E-03	4.1600E-02	2,8000E+00
56	1,9000E+03	8.7800E+00	0,0000E+00	3,9686E-04	4.1600E-02	2,8000E+00
57	1,9200E+03	8.7800E+00	0,0000E+00	3,6536E-04	4.1600E-02	2,8000E+00
58	1,9400E+03	8.7800E+00	0,0000E+00	3,3282E-04	4.1600E-02	2,8000E+00
59	1,9500E+03	8.7800E+00	0,0000E+00	7,0435E-04	4.1600E-02	2,8000E+00
60	2,1000E+03	8.7800E+00	0,0000E+00	8,4514E-04	4.1600E-02	2,8000E+00
61	2,2000E+03	8.7800E+00	0,0000E+00	9,0028E-04	4.1600E-02	2,8000E+00
62	2,4000E+03	8.7800E+00	0.0000E+00	1,0488E-03	4.1600E-02	2,8000E+00
63	2,4500E+03	8.7800E+00	0,0000E+00	1,1868E-03	4.1600E-02	2,8000E+00
64	2,6000E+03	8.7800E+00	0,0000E+00	9,8290E-04	4.1600E-02	2,8000E+00
65	2,6200E+03	8.7800E+00	0,0000E+00	4,4050E-04	4.1600E-02	2,8000E+00
66	2,6400E+03	8.7800E+00	0,0000E+00	4,3261E-04	4.1600E-02	2,8000E+00
67	2,6600E+03	8.7800E+00	0,0000E+00	4,2482E-04	4.1600E-02	2,8000E+00
68	2,6800E+03	8.7800E+00	0,0000E+00	4,1699E-04	4.1600E-02	2,8000E+00
69	2,7000E+03	8.7800E+00	0,0000E+00	4,0901E-04	4.1600E-02	2.8000E+00
70	2,7200E+03	8.7800E+00	0,0000E+00	4,0118E-04	4.1600E-02	2,8000E+00
71	2,7400E+03	8.7800E+00	0,0000E+00	3,9339E-04	4.1600E-02	2,8000E+00
72	2,7500E+03	8.7800E+00	0,0000E+00	8,7917E-04	4.1600E-02	2,8000E+00
73	2,7750E+03	8.7800E+00	0,0000E+00	4,3775E-04	4.1600E-02	2,8000E+00
74	2,8000E+03	8.7800E+00	0,0000E+00	1,1017E-03	4.1600E-02	2,8000E+00
75	2,9000E+03	8.7800E+00	0,0000E+00	4,8996E-04	4.1600E-02	2,8000E+00
76	3,0750E+03	8.7800E+00	0,0000E+00	5,0271E-04	4.1600E-02	2,8000E+00
77	3,2500E+03	8.7800E+00	0,0000E+00	7,9000E-04	4.1600E-02	2,8000E+00
78	3,7500E+03	8.7800E+00	0,0000E+00	9,6457E-04	4.1600E-02	2,8000E+00
79	4,2500E+03	8.7800E+00	0,0000E+00	8,5307E-04	4.1600E-02	2,8000E+00
80	4,7500E+03	8.7800E+00	0,0000E+00	9,0374E-04	4.1600E-02	2,8000E+00
81	5,2500E+03	8.7800E+00	0.0000E+00	9,4552E-04	4.1600E-02	2,8000E+00
82	5,7500E+03	8.7800E+00	0,0000E+00	9,0362E-04	4.1600E-02	2,8000E+00
83	6,2500E+03	8.7800E+00	0,0000E+00	8,9375E-04	4.1600E-02	2,8000E+00
84	6,7500E+03	8.7800E+00	0,0000E+00	8,0529E-04	4.1600E-02	2,8000E+00
85	7,2500E+03	8.7800E+00	0,0000E+00	7,9653E-04	4.1600E-02	2,8000E+00
86	8,2500E+03	8.7800E+00	0,0000E+00	8,8419E-04	4.1600E-02	2,8000E+00
87	8,7500E+03	8.7800E+00	0,0000E+00	7,5504E-04	4.1600E-02	2,8000E+00
88	9,2500E+03	8.7800E+00	0,0000E+00	8,4041E-04	4.1600E-02	2,8000E+00
89	9,5000E+03	8.7800E+00	0,0000E+00	3,5814E-04	4.1600E-02	2,8000E+00
90	9,7500E+03	8.7800E+00	0,0000E+00	7,3440E-04	4.1600E-02	2,8000E+00
91	1,0000E+04	8.7800E+00	0,0000E+00	7,7887E-04	4.1600E-02	2,8000E+00
92	1,5000E+04	8.7800E+00	0,0000E+00	7,8440E-04	4.1600E-02	2,8000E+00
93	2,0000E+04	8.7800E+00	0,0000E+00	5,0864E-04	4.1600E-02	2,8000E+00
94	2,5000E+04	8.7800E+00	0,0000E+00	2,8290E-04	4.1600E-02	2,8000E+00

	J-VALUE	COMPETITIVE	NEUTRON	RADIATION	FISSION
DEGREES OF FREEDOM USED IN THE WIDTH DISTRIBUTION	1.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	1.0000E+00

AVERAGE RESONANCE WIDTHS (EV)

INDEX	ENERGY (EV)	LEVEL SPACING	COMPETITIVE	NEUTRON	RADIATION	FISSION
1	3.0100E+02	3.1154E+00	0.0000E+00	4.5170E-04	4.1600E-02	1.1930E-02
2	3.2000E+02	3.1154E+00	0.0000E+00	4.8174E-04	4.1600E-02	3.6375E-02
3	3.4000E+02	3.1154E+00	0.0000E+00	3.9544E-04	4.1600E-02	4.2973E-02
4	3.6000E+02	3.1154E+00	0.0000E+00	3.0799E-04	4.1600E-02	5.4730E-02
5	3.8000E+02	3.1154E+00	0.0000E+00	1.8314E-04	4.1600E-02	4.4729E-02
6	4.0400E+02	3.1154E+00	0.0000E+00	2.3568E-04	4.1600E-02	9.9986E-02
7	4.3000E+02	3.1154E+00	0.0000E+00	2.8519E-04	4.1600E-02	2.0420E-01
8	4.6000E+02	3.1154E+00	0.0000E+00	2.8607E-04	4.1600E-02	2.8735E-01
9	4.9200E+02	3.1154E+00	0.0000E+00	2.3677E-04	4.1600E-02	3.0788E-01
10	4.9500E+02	3.1154E+00	0.0000E+00	3.8876E-04	4.1600E-02	2.9067E-01
11	4.9800E+02	3.1154E+00	0.0000E+00	5.0314E-04	4.1600E-02	2.2552E-01
12	5.0100E+02	3.1154E+00	0.0000E+00	6.2863E-04	4.1600E-02	1.8769E-01
13	5.0400E+02	3.1154E+00	0.0000E+00	6.2419E-04	4.1600E-02	1.0415E-01
14	5.4600E+02	3.1154E+00	0.0000E+00	7.3140E-04	4.1600E-02	7.1369E-02
15	5.5500E+02	3.1154E+00	0.0000E+00	6.3481E-04	4.1600E-02	2.1550E-02
16	5.9500E+02	3.1154E+00	0.0000E+00	6.7452E-04	4.1600E-02	2.0514E-02
17	6.0000E+02	3.1154E+00	0.0000E+00	3.3680E-04	4.1600E-02	6.5029E-03
18	6.4000E+02	3.1154E+00	0.0000E+00	2.6274E-04	4.1600E-02	7.8529E-03
19	7.2500E+02	3.1154E+00	0.0000E+00	2.0572E-04	4.1600E-02	2.1544E-02
20	7.7500E+02	3.1154E+00	0.0000E+00	3.3086E-04	4.1600E-02	4.1203E-02
21	8.0000E+02	3.1154E+00	0.0000E+00	3.4304E-04	4.1600E-02	9.9130E-02
22	8.2500E+02	3.1154E+00	0.0000E+00	2.3163E-04	4.1600E-02	8.8579E-02
23	8.5000E+02	3.1154E+00	0.0000E+00	2.8615E-04	4.1600E-02	7.7324E-02
24	8.6000E+02	3.1154E+00	0.0000E+00	2.8814E-04	4.1600E-02	6.0307E-02
25	8.7000E+02	3.1154E+00	0.0000E+00	2.9007E-04	4.1600E-02	4.6715E-02
26	8.7500E+02	3.1154E+00	0.0000E+00	2.3651E-04	4.1600E-02	1.7496E-02
27	9.2500E+02	3.1154E+00	0.0000E+00	3.1011E-04	4.1600E-02	4.5130E-02
28	9.7500E+02	3.1154E+00	0.0000E+00	5.6205E-04	4.1600E-02	6.0212E-02
29	1.0400E+03	3.1154E+00	0.0000E+00	3.2670E-04	4.1600E-02	5.3425E-02
30	1.1600E+03	3.1154E+00	0.0000E+00	3.3234E-04	4.1600E-02	4.3526E-02
31	1.2500E+03	3.1154E+00	0.0000E+00	2.9282E-04	4.1600E-02	1.9867E-02
32	1.2600E+03	3.1154E+00	0.0000E+00	3.6441E-04	4.1600E-02	5.6751E-02
33	1.2700E+03	3.1154E+00	0.0000E+00	3.6465E-04	4.1600E-02	7.1160E-02
34	1.2800E+03	3.1154E+00	0.0000E+00	3.6474E-04	4.1600E-02	8.8922E-02
35	1.2900E+03	3.1154E+00	0.0000E+00	3.6468E-04	4.1600E-02	1.1095E-01
36	1.3000E+03	3.1154E+00	0.0000E+00	3.6449E-04	4.1600E-02	1.3884E-01
37	1.3100E+03	3.1154E+00	0.0000E+00	3.6417E-04	4.1600E-02	1.7426E-01
38	1.3200E+03	3.1154E+00	0.0000E+00	3.6373E-04	4.1600E-02	2.2005E-01
39	1.3300E+03	3.1154E+00	0.0000E+00	3.6317E-04	4.1600E-02	2.8016E-01
40	1.3400E+03	3.1154E+00	0.0000E+00	3.6249E-04	4.1600E-02	3.6171E-01
41	1.3500E+03	3.1154E+00	0.0000E+00	2.9971E-04	4.1600E-02	3.4440E-01
42	1.3700E+03	3.1154E+00	0.0000E+00	3.5567E-04	4.1600E-02	3.6414E-01
43	1.3900E+03	3.1154E+00	0.0000E+00	3.4931E-04	4.1600E-02	2.7964E-01
44	1.4100E+03	3.1154E+00	0.0000E+00	3.4259E-04	4.1600E-02	2.1477E-01
45	1.4300E+03	3.1154E+00	0.0000E+00	3.3549E-04	4.1600E-02	1.6390E-01

46	1.4500E+03	3.1154E+00	0.0000E+00	3.2797E-04	4.1600E-02	1.2385E-01
47	1.4700E+03	3.1154E+00	0.0000E+00	3.2001E-04	4.1600E-02	9.2121E-02
48	1.4900E+03	3.1154E+00	0.0000E+00	3.1157E-04	4.1600E-02	6.7106E-02
49	1.5100E+03	3.1154E+00	0.0000E+00	3.0260E-04	4.1600E-02	4.7254E-02
50	1.5300E+03	3.1154E+00	0.0000E+00	2.9306E-04	4.1600E-02	3.1589E-02
51	1.5400E+03	3.1154E+00	0.0000E+00	2.8805E-04	4.1600E-02	2.5067E-02
52	1.5500E+03	3.1154E+00	0.0000E+00	2.2617E-04	4.1600E-02	3.7374E-03
53	1.7000E+03	3.1154E+00	0.0000E+00	3.3585E-04	4.1600E-02	1.1227E-02
54	1.8000E+03	3.1154E+00	0.0000E+00	3.4659E-04	4.1600E-02	2.4184E-02
55	1.8500E+03	3.1154E+00	0.0000E+00	3.7947E-04	4.1600E-02	5.8232E-02
56	1.9000E+03	3.1154E+00	0.0000E+00	3.9686E-04	4.1600E-02	5.1066E-02
57	1.9200E+03	3.1154E+00	0.0000E+00	3.6536E-04	4.1600E-02	3.5165E-02
58	1.9400E+03	3.1154E+00	0.0000E+00	3.3282E-04	4.1600E-02	2.1570E-02
59	1.9500E+03	3.1154E+00	0.0000E+00	2.4993E-04	4.1600E-02	1.2848E-03
60	2.1000E+03	3.1154E+00	0.0000E+00	2.9988E-04	4.1600E-02	4.7856E-03
61	2.2000E+03	3.1154E+00	0.0000E+00	3.1944E-04	4.1600E-02	6.8320E-03
62	2.4000E+03	3.1154E+00	0.0000E+00	3.7214E-04	4.1600E-02	1.7292E-02
63	2.4500E+03	3.1154E+00	0.0000E+00	4.2112E-04	4.1600E-02	3.0168E-02
64	2.6000E+03	3.1154E+00	0.0000E+00	3.4876E-04	4.1600E-02	5.3702E-03
65	2.6200E+03	3.1154E+00	0.0000E+00	4.4050E-04	4.1600E-02	3.1875E-02
66	2.6400E+03	3.1154E+00	0.0000E+00	4.3261E-04	4.1600E-02	4.2020E-02
67	2.6600E+03	3.1154E+00	0.0000E+00	4.2482E-04	4.1600E-02	5.4745E-02
68	2.6800E+03	3.1154E+00	0.0000E+00	4.1699E-04	4.1600E-02	7.0973E-02
69	2.7000E+03	3.1154E+00	0.0000E+00	4.0901E-04	4.1600E-02	9.1998E-02
70	2.7200E+03	3.1154E+00	0.0000E+00	4.0118E-04	4.1600E-02	1.1953E-01
71	2.7400E+03	3.1154E+00	0.0000E+00	3.9339E-04	4.1600E-02	1.5655E-01
72	2.7500E+03	3.1154E+00	0.0000E+00	3.1854E-04	4.1600E-02	1.1885E-01
73	2.7750E+03	3.1154E+00	0.0000E+00	4.3775E-04	4.1600E-02	1.0821E-01
74	2.8000E+03	3.1154E+00	0.0000E+00	3.9091E-04	4.1600E-02	3.5497E-02
75	2.9000E+03	3.1154E+00	0.0000E+00	7.2584E-04	4.1600E-02	3.7189E-02
76	3.0750E+03	3.1154E+00	0.0000E+00	5.0271E-04	4.1600E-02	5.0502E-02
77	3.2500E+03	3.1154E+00	0.0000E+00	2.8030E-04	4.1600E-02	5.8628E-02
78	3.7500E+03	3.1154E+00	0.0000E+00	3.4227E-04	4.1600E-02	2.0377E-02
79	4.2500E+03	3.1154E+00	0.0000E+00	3.0270E-04	4.1600E-02	1.2379E-02
80	4.7500E+03	3.1154E+00	0.0000E+00	3.2067E-04	4.1600E-02	2.4301E-02
81	5.2500E+03	3.1154E+00	0.0000E+00	3.3550E-04	4.1600E-02	1.0552E-02
82	5.7500E+03	3.1154E+00	0.0000E+00	3.2062E-04	4.1600E-02	2.1732E-02
83	6.2500E+03	3.1154E+00	0.0000E+00	3.1713E-04	4.1600E-02	2.0652E-02
84	6.7500E+03	3.1154E+00	0.0000E+00	2.8575E-04	4.1600E-02	1.2612E-02
85	7.2500E+03	3.1154E+00	0.0000E+00	2.8263E-04	4.1600E-02	2.5165E-02
86	8.2500E+03	3.1154E+00	0.0000E+00	3.1374E-04	4.1600E-02	3.6851E-02
87	8.7500E+03	3.1154E+00	0.0000E+00	2.6791E-04	4.1600E-02	5.4350E-02
88	9.2500E+03	3.1154E+00	0.0000E+00	2.9821E-04	4.1600E-02	1.2342E-02
89	9.5000E+03	3.1154E+00	0.0000E+00	3.5814E-04	4.1600E-02	5.9970E-02
90	9.7500E+03	3.1154E+00	0.0000E+00	2.6059E-04	4.1600E-02	5.8000E-02
91	1.0000E+04	3.1154E+00	0.0000E+00	2.7637E-04	4.1600E-02	2.8128E-02
92	1.5000E+04	3.1154E+00	0.0000E+00	2.7833E-04	4.1600E-02	2.8395E-02
93	2.0000E+04	3.1154E+00	0.0000E+00	3.1291E-04	4.1600E-02	4.9416E-02
94	2.5000E+04	3.1154E+00	0.0000E+00	3.1237E-04	4.1600E-02	8.0800E-02

L VALUE-------------------------- 1
NUMBER OF J STATES------------- 3

			DEGREES OF FREEDOM USED IN THE WIDTH DISTRIBUTION			
		J-VALUE	COMPETITIVE	NEUTRON	RADIATION	FISSION
		0.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00

			AVERAGE RESONANCE WIDTHS (EV)			
INDEX	ENERGY (EV)	LEVEL SPACING	COMPETITIVE	NEUTRON	RADIATION	FISSION
1	3.0100E+02	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
2	3.2000E+02	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
3	3.4000E+02	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
4	3.6000E+02	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
5	3.8000E+02	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
6	4.0400E+02	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
7	4.3000E+02	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
8	4.6000E+02	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
9	4.9200E+02	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
10	4.9500E+02	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
11	4.9800E+02	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
12	5.0100E+02	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
13	5.0400E+02	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
14	5.4600E+02	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
15	5.5500E+02	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
16	5.9500E+02	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
17	6.0000E+02	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
18	6.4000E+02	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
19	7.2500E+02	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
20	7.7500E+02	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
21	8.0000E+02	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
22	8.2500E+02	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
23	8.5000E+02	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
24	8.6000E+02	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
25	8.7000E+02	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
26	8.7500E+02	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
27	9.2500E+02	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
28	9.7500E+02	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
29	1.0400E+03	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
30	1.1600E+03	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
31	1.2500E+03	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
32	1.2600E+03	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
33	1.2700E+03	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
34	1.2800E+03	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
35	1.2900E+03	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
36	1.3000E+03	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
37	1.3100E+03	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
38	1.3200E+03	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
39	1.3300E+03	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
40	1.3400E+03	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
41	1.3500E+03	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
42	1.3700E+03	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10
43	1.3900E+03	8.7800E+00	0.0000E+00	1.7560E-03	4.1600E-02	1.0000E-10

44	1,4100E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
45	1,4300E+03	8.7600E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
46	1,4500E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
47	1,4700E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
48	1,4900E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
49	1,5100E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
50	1,5300E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
51	1,5400E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
52	1,5500E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
53	1,7000E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
54	1,8000E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
55	1,8500E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
56	1,9000E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
57	1,9200E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
58	1,9400E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
59	1,9500E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
60	2,1000E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
61	2,2000E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
62	2,4000E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
63	2,4500E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
64	2,6000E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
65	2,6200E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
66	2,6400E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
67	2,6600E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
68	2,6800E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
69	2,7000E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
70	2,7200E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
71	2,7400E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
72	2,7500E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
73	2,7750E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
74	2,8000E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
75	2,9000E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
76	3,0750E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
77	3,2500E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
78	3,7500E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
79	4,2500E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
80	4,7500E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
81	5,2500E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
82	5,7500E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
83	6,2500E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
84	6,7500E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
85	7,2500E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
86	8,2500E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
87	8,7500E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
88	9,2500E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
89	9,5000E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
90	9,7500E+03	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
91	1,0000E+04	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
92	1,5000E+04	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
93	2,0000E+04	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10
94	2,5000E+04	8.7800E+00	0,0000E+00	1,7560E-03	4.1600E-02	1.0000E-10

			DEGREES OF FREEDOM USED IN THE WIDTH DISTRIBUTION			
		J-VALUE	COMPETITIVE	NEUTRON	RADIATION	FISSION
		1.0000E+00	0.0000E+00	2.0000E+00	0.0000E+00	2.0000E+00
			AVERAGE RESONANCE WIDTHS (EV)			
INDEX	ENERGY (EV)	LEVEL SPACING	COMPETITIVE	NEUTRON	RADIATION	FISSION
1	3.0100E+02	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
2	3.2000E+02	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
3	3.4000E+02	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
4	3.6000E+02	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
5	3.8000E+02	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
6	4.0400E+02	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
7	4.3000E+02	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
8	4.6000E+02	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
9	4.9200E+02	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
10	4.9500E+02	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
11	4.9800E+02	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
12	5.0100E+02	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
13	5.0400E+02	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
14	5.4600E+02	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
15	5.5500E+02	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
16	5.9500E+02	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
17	6.0000E+02	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
18	6.4000E+02	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
19	7.2500E+02	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
20	7.7500E+02	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
21	8.0000E+02	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
22	8.2500E+02	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
23	8.5000E+02	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
24	8.6000E+02	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
25	8.7000E+02	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
26	8.7500E+02	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
27	9.2500E+02	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
28	9.7500E+02	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
29	1.0400E+03	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
30	1.1600E+03	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
31	1.2500E+03	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
32	1.2600E+03	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
33	1.2700E+03	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
34	1.2800E+03	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
35	1.2900E+03	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
36	1.3000E+03	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
37	1.3100E+03	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
38	1.3200E+03	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
39	1.3300E+03	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
40	1.3400E+03	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
41	1.3500E+03	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
42	1.3700E+03	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00
43	1.3900E+03	3.1154E+00	0.0000E+00	6.2308E-04	4.1600E-02	1.0000E+00

44	1,4100E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
45	1,4300E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
46	1,4500E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
47	1,4700E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
48	1,4900E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
49	1,5100E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
50	1,5300E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
51	1,5400E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
52	1,5500E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
53	1,7000E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
54	1,8000E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
55	1,8500E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
56	1,9000E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
57	1,9200E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
58	1,9400E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
59	1,9500E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
60	2,1000E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
61	2,2000E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
62	2,4000E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
63	2,4500E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
64	2,6000E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
65	2,6200E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
66	2,6400E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
67	2,6600E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
68	2,6800E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
69	2,7000E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
70	2,7200E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
71	2,7400E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
72	2,7500E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
73	2,7750E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
74	2,8000E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
75	2,9000E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
76	3,0750E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
77	3,2500E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
78	3,7500E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
79	4,2500E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
80	4,7500E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
81	5,2500E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
82	5,7500E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
83	6,2500E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
84	6,7500E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
85	7,2500E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
86	8,2500E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
87	8,7500E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
88	9,2500E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
89	9,5000E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
90	9,7500E+03	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
91	1,0000E+04	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
92	1,5000E+04	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
93	2,0000E+04	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00
94	2,5000E+04	3.1154E+00	0,0000E+00	6,2308E-04	4.1600E-02	1,0000E+00

		DEGREES OF FREEDOM USED IN THE WIDTH DISTRIBUTION			
J-VALUE	COMPETITIVE	NEUTRON	RADIATION	FISSION	
2.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	3.0000E+00	

AVERAGE RESONANCE WIDTHS (EV)

INDEX	ENERGY (EV)	LEVEL SPACING	COMPETITIVE	NEUTRON	RADIATION	FISSION
1	3.0100E+02	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
2	3.2000E+02	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
3	3.4000E+02	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
4	3.6000E+02	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
5	3.8000E+02	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
6	4.0400E+02	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
7	4.3000E+02	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
8	4.6000E+02	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
9	4.9200E+02	2.1181E+00	0.0000E+00	4.2363E-24	4.1600E-02	1.0000E+00
10	4.9500E+02	2.1181E+00	0.0000E+00	4.2363E-24	4.1600E-02	1.0000E+00
11	4.9800E+02	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
12	5.0100E+02	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
13	5.0400E+02	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
14	5.4600E+02	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
15	5.5500E+02	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
16	5.9500E+02	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
17	6.0000E+02	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
18	6.4000E+02	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
19	7.2500E+02	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
20	7.7500E+02	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
21	8.0000E+02	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
22	8.2500E+02	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
23	8.5000E+02	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
24	8.6000E+02	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
25	8.7000E+02	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
26	8.7500E+02	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
27	9.2500E+02	2.1181E+00	0.0000E+00	4.2363E-24	4.1600E-02	1.0000E+00
28	9.7500E+02	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
29	1.0400E+03	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
30	1.1600E+03	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
31	1.2500E+03	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
32	1.2600E+03	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
33	1.2700E+03	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
34	1.2800E+03	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
35	1.2900E+03	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
36	1.3000E+03	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
37	1.3100E+03	2.1181E+00	0.0000E+00	4.2363E-24	4.1600E-02	1.0000E+00
38	1.3200E+03	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
39	1.3300E+03	2.1181E+00	0.0000E+00	4.2363E-24	4.1600E-02	1.0000E+00
40	1.3400E+03	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
41	1.3500E+03	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
42	1.3700E+03	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
43	1.3900E+03	2.1181E+00	0.0000E+00	4.2363E-04	4.1600E-02	1.0000E+00

44	1,4100E+03	2.1181E+00	0,0000E+00	4.2363E-04	4.1600E-02	1.0000E+00
45	1,4300E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
46	1,4500E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
47	1,4700E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
48	1,4900E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
49	1,5100E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
50	1,5300E+03	2.1181E+00	0,0000E+00	4,2363E-04	4,1600E-02	1,0000E+00
51	1,5400E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1.0000E+00
52	1,5500E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
53	1,7000E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
54	1,8000E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1.0000E+00
55	1,8500E+03	2,1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
56	1,9000E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
57	1,9200E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
58	1,9400E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1.0000E+00
59	1,9500E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
60	2,1000E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1.0000E+00
61	2,2000E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1.0000E+00
62	2,4000E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
63	2,4500E+03	2.1181E+00	0.0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
64	2,6000E+03	2.1181E+00	0,0000E+00	4,2363E-04	4,1600E-02	1,0000E+00
65	2,6200E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
66	2,6400E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
67	2,6600E+03	2.1181E+00	0.0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
68	2,6800E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
69	2,7000E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
70	2,7200E+03	2.1181E+00	0,0000E+00	4,2363E-04	4,1600E-02	1.0000E+00
71	2,7400E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
72	2,7500E+03	2.1181E+00	0,0000E+00	4,2363E-04	4,1600E-02	1,0000E+00
73	2,7750E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
74	2,8000E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1.0000E+00
75	2,9000E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
76	3,0750E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
77	3,2500E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1.0000E+00
78	3,7500E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
79	4,2500E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1.0000E+00
80	4,7500E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
81	5,2500E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
82	5,7500E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
83	6,2500E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
84	6,7500E+03	2,1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
85	7,2500E+03	2,1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
86	8,2500E+03	2,1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
87	8,7500E+03	2,1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
88	9,2500E+03	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
89	9,5000E+03	2,1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
90	9,7500E+03	2,1181E+00	0,0000E+00	4,2363E-04	4,1600E-02	1,0000E+00
91	1,0000E+04	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
92	1,5000E+04	2,1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
93	2,0000E+04	2.1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00
94	2,5000E+04	2,1181E+00	0,0000E+00	4,2363E-04	4.1600E-02	1,0000E+00

REACTION Q VALUE 1.9860E+08 EV

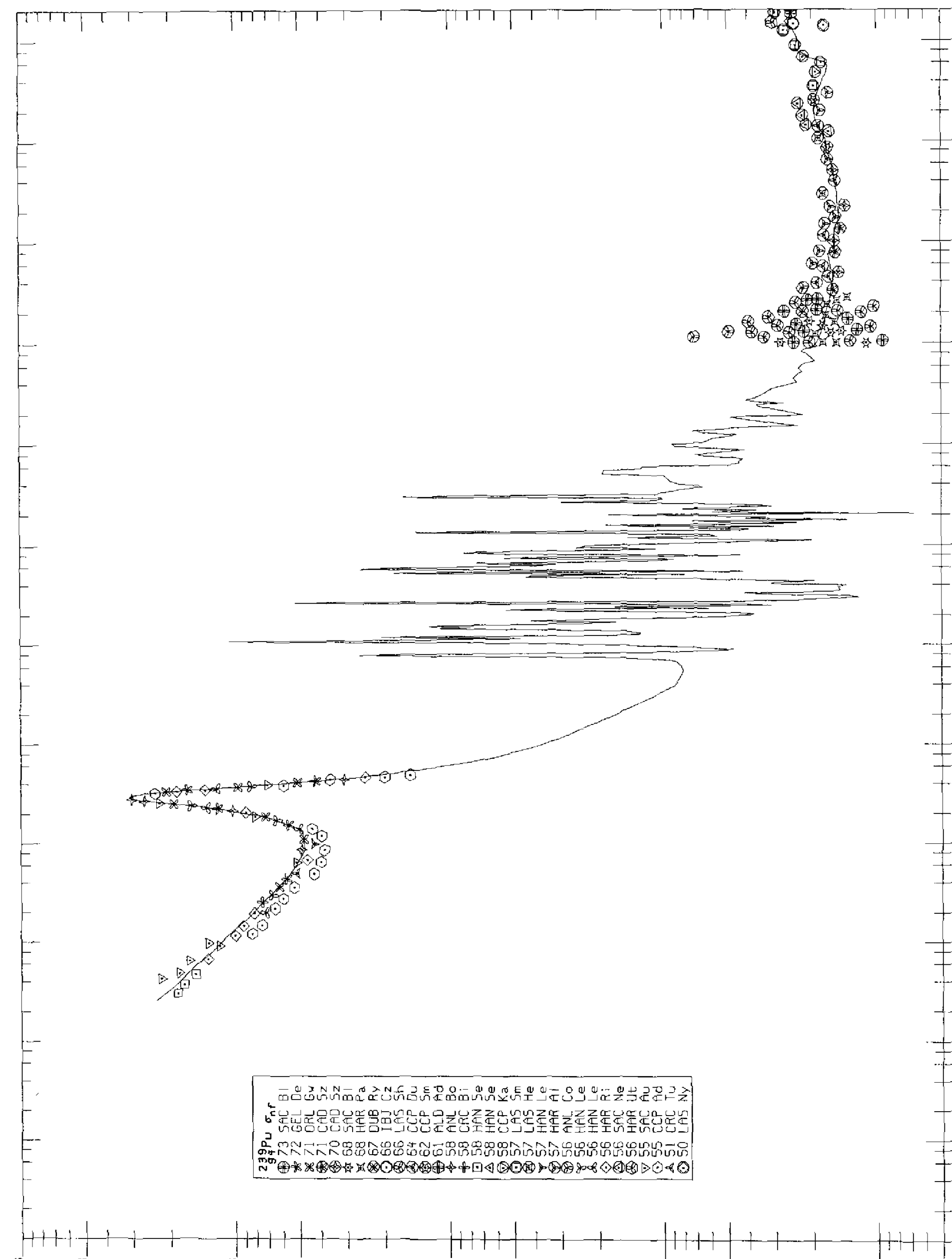
INTERPOLATION LAW BETWEEN ENERGIES

RANGE	DESCRIPTION
1 TO 470	Y LINEAR IN X

NEUTRON CROSS SECTIONS

INDEX,	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS	ENERGY EV	CROSS SECTION BARNS
1	1.0000E-05	3.6588E+04	5.0000E-05	1.6365E+04	1.0000E-04	1.1574E+04	5.0000E-04	5.1744E+03	1.0000E-03	3.6600E+03
6	2.0000E-03	2.5688E+03	3.0000E-03	2.1144E+03	4.0000E-03	1.8318E+03	5.0000E-03	1.6391E+03	6.0000E-03	1.4970E+03
11	7.0000E-03	1.3866E+03	8.0000E-03	1.2978E+03	9.0000E-03	1.2243E+03	1.0000E-02	1.1623E+03	1.1000E-02	1.1089E+03
16	1.2000E-02	1.0625E+03	1.3000E-02	1.0215E+03	1.4000E-02	9.8510E+02	1.5000E-02	9.5243E+02	1.6000E-02	9.2294E+02
21	1.7000E-02	8.9615E+02	1.8000E-02	8.7173E+02	1.9000E-02	8.4936E+02	2.0000E-02	8.2875E+02	2.1000E-02	8.0972E+02
26	2.2000E-02	7.9204E+02	2.3000E-02	7.7560E+02	2.4000E-02	7.6029E+02	2.5300E-02	7.4170E+02	2.7500E-02	7.1412E+02
31	3.0000E-02	6.8653E+02	3.2500E-02	6.6099E+02	3.5000E-02	6.4158E+02	3.7500E-02	6.2217E+02	4.0000E-02	6.0480E+02
36	4.2500E-02	5.9050E+02	4.5000E-02	5.7518E+02	4.7500E-02	5.6394E+02	5.0000E-02	5.5270E+02	5.2500E-02	5.4248E+02
41	5.5000E-02	5.3329E+02	5.7500E-02	5.2511E+02	6.0000E-02	5.1796E+02	6.2500E-02	5.1081E+02	6.5000E-02	5.0571E+02
46	6.7500E-02	4.9958E+02	7.0000E-02	4.9549E+02	7.2500E-02	4.9038E+02	7.5000E-02	4.8731E+02	7.7500E-02	4.8323E+02
51	8.0000E-02	4.7914E+02	8.2500E-02	4.7710E+02	8.5000E-02	4.7506E+02	8.7500E-02	4.7403E+02	9.0000E-02	4.7199E+02
56	9.2500E-02	4.7199E+02	9.5000E-02	4.7097E+02	9.7500E-02	4.7097E+02	1.0000E-01	4.7097E+02	1.0500E-01	4.7097E+02
61	1.1000E-01	4.7097E+02	1.1500E-01	4.7301E+02	1.2000E-01	4.7812E+02	1.2500E-01	4.8323E+02	1.3000E-01	4.9140E+02
66	1.3500E-01	4.9855E+02	1.4000E-01	5.0775E+02	1.4500E-01	5.2307E+02	1.5000E-01	5.3737E+02	1.5500E-01	5.5270E+02
71	1.6000E-01	5.7313E+02	1.6500E-01	5.9561E+02	1.7000E-01	6.2217E+02	1.7500E-01	6.5384E+02	1.8000E-01	6.8449E+02
76	1.8500E-01	7.2433E+02	1.9000E-01	7.6826E+02	1.9500E-01	8.1321E+02	2.0000E-01	8.7349E+02	2.1000E-01	9.9098E+02
81	2.2000E-01	1.1483E+03	2.3000E-01	1.3373E+03	2.4000E-01	1.5947E+03	2.5000E-01	1.9012E+03	2.6000E-01	2.2782E+03
86	2.7000E-01	2.6225E+03	2.8000E-01	2.9341E+03	2.9000E-01	3.0986E+03	3.0000E-01	3.1037E+03	3.1000E-01	2.9402E+03
91	3.2000E-01	2.6143E+03	3.3000E-01	2.2067E+03	3.4000E-01	1.8113E+03	3.5000E-01	1.4997E+03	3.6000E-01	1.2321E+03
96	3.7000E-01	1.0410E+03	3.8000E-01	8.8166E+02	3.9000E-01	7.4476E+02	4.0000E-01	6.3443E+02	4.1000E-01	5.4759E+02
101	4.2000E-01	4.6893E+02	4.3000E-01	4.1172E+02	4.4000E-01	3.6165E+02	4.5000E-01	3.2079E+02	4.6000E-01	2.8810E+02
106	4.7000E-01	2.6256E+02	4.8000E-01	2.4213E+02	4.9000E-01	2.2271E+02	5.0000E-01	2.0535E+02	5.1000E-01	1.8389E+02
111	5.2000E-01	1.7266E+02	5.3000E-01	1.6039E+02	5.4000E-01	1.5120E+02	5.5000E-01	1.3996E+02	5.6000E-01	1.3281E+02
116	5.7000E-01	1.2566E+02	5.8000E-01	1.1953E+02	5.9000E-01	1.1340E+02	6.0000E-01	1.0625E+02	6.1000E-01	1.0104E+02
121	6.2000E-01	9.6544E+01	6.3000E-01	9.1742E+01	6.4000E-01	8.8371E+01	6.5000E-01	8.4488E+01	6.6000E-01	8.1219E+01
126	6.7000E-01	7.8665E+01	6.8000E-01	7.5498E+01	6.9000E-01	7.3046E+01	7.0000E-01	7.0696E+01	7.1000E-01	6.8755E+01
131	7.2000E-01	6.6610E+01	7.3000E-01	6.4362E+01	7.4000E-01	6.2626E+01	7.5000E-01	6.0991E+01	7.6000E-01	5.9356E+01
136	7.7000E-01	5.7722E+01	7.8000E-01	5.6189E+01	7.9000E-01	5.5270E+01	8.0000E-01	5.4248E+01	8.1000E-01	5.2818E+01
141	8.2000E-01	5.1286E+01	8.3000E-01	5.0366E+01	8.4000E-01	4.9549E+01	8.5000E-01	4.8119E+01	8.6000E-01	4.7301E+01
146	8.7000E-01	4.6484E+01	8.8000E-01	4.5462E+01	8.9000E-01	4.4441E+01	9.0000E-01	4.3419E+01	9.1000E-01	4.2908E+01
151	9.2000E-01	4.1784E+01	9.3000E-01	4.1274E+01	9.4000E-01	4.0354E+01	9.5000E-01	3.9843E+01	9.6000E-01	3.8924E+01
156	9.7000E-01	3.8617E+01	9.8000E-01	3.7902E+01	9.9000E-01	3.7187E+01	1.0000E+00	3.6472E+01	1.0000E+00	1.9460E+01
161	2.0000E+00	1.1840E+01	3.0000E+00	8.1800E+00	3.9000E+00	6.3100E+00	6.4500E+00	4.7500E+00	9.0000E+00	-2.3613E+00
166	1.1125E+01	3.5755E+00	1.3250E+01	3.7070E+00	1.5125E+01	4.1277E+00	1.7000E+01	5.1677E+00	1.8500E+01	3.4955E+00
171	2.0000E+01	7.4645E-01	2.2250E+01	2.3434E-01	2.4500E+01	6.8701E-01	2.7250E+01	1.1664E+00	3.0000E+01	-3.0201E-01
176	3.2000E+01	1.6230E-01	3.4000E+01	2.6835E-02	3.6000E+01	-1.4120E-01	3.8000E+01	-3.0420E-01	3.8500E+01	-3.5000E-01
181	3.9000E+01	-3.6482E-01	4.1250E+01	-1.7650E+00	4.3500E+01	-1.5961E+00	4.6100E+01	7.1692E-01	4.8700E+01	-1.5221E+00
186	5.0100E+01	-5.1925E+00	5.1500E+01	-3.7067E+00	5.3000E+01	-4.5525E+00	5.4500E+01	-1.0225E+01	5.8000E+01	3.7723E+00
191	6.1500E+01	-4.2115E-01	6.3000E+01	7.2503E-01	6.4500E+01	-8.9052E+00	6.6000E+01	2.3000E+00	6.7000E+01	1.5000E+01
196	6.8000E+01	4.0000E+00	6.9000E+01	3.5000E+00	7.1000E+01	1.5943E+00	7.5000E+01	3.2723E+00	7.9000E+01	-5.5402E+00
201	8.5750E+01	2.1735E+00	9.2500E+01	1.4467E+00	9.7250E+01	3.2688E-01	1.0200E+02	-3.2545E-01	1.0550E+02	1.1095E+00
206	1.0900E+02	6.2579E-01	1.1050E+02	-3.2603E-01	1.1200E+02	-7.1845E-01	1.1475E+02	-2.1451E+00	1.1750E+02	6.7379E+00
211	1.2000E+02	8.2110E-01	1.2250E+02	2.8155E+00	1.3175E+02	-2.8342E+00	1.4100E+02	-6.4300E-02	1.4625E+02	-1.0128E+00
216	1.5150E+02	1.5696E+00	1.5675E+02	3.3755E+00	1.6200E+02	1.5292E+00	1.6775E+02	2.1946E-02	1.7350E+02	5.8725E-01
221	1.7425E+02	7.7725E-01	1.7500E+02	3.5241E-01	1.7775E+02	-4.7563E-01	1.8050E+02	1.0867E+00	1.8500E+02	1.8631E-01
226	1.8950E+02	-7.4685E-01	1.9100E+02	-6.9717E-01	1.9250E+02	-1.5600E+00	1.9700E+02	-4.9237E+00	2.0150E+02	5.6522E+00
231	2.0550E+02	-3.1005E+00	2.0950E+02	-7.7764E-01	2.1225E+02	-7.4640E-01	2.1500E+02	2.4285E+00	2.1835E+02	-2.5972E-01
236	2.2170E+02	-7.4006E-03	2.2760E+02	-1.2796E+00	2.3350E+02	6.5300E-01	2.3550E+02	4.2704E+00	2.3750E+02	2.1290E+00
241	2.3925E+02	2.4234E-02	2.4100E+02	1.7770E+00	2.4325E+02	-5.2420E-01	2.4550E+02	1.1577E+00	2.4935E+02	-8.6114E-02

246	2,5320E+02	9,5075E-01	2,6535E+02	-2,8958E+00	2,7750E+02	5,5068E+00	2,8375E+02	-2,2923E-01	2,9000E+02	1,2537E+00
251	2,9225E+02	6,1968E-01	2,9450E+02	5,7340E-01	2,9725E+02	-5,6433E-01	3,0000E+02	9,8020E-01	3,0100E+02	1,0364E+01
256	3,0100E+02	0,0000E+00	2,0000E+04	0,0000E+00	2,2500E+04	0,0000E+00	2,5000E+04	2,5000E-03	2,5000E+04	1,6425E+00
261	2,8000E+04	1,6325E+00	3,0000E+04	1,6258E+00	3,2000E+04	1,6184E+00	3,3000E+04	1,6150E+00	3,5000E+04	1,6105E+00
266	3,6000E+04	1,6080E+00	3,8000E+04	1,6055E+00	4,0000E+04	1,6035E+00	4,3000E+04	1,6000E+00	4,5000E+04	1,5900E+00
271	4,7000E+04	1,5700E+00	4,8000E+04	1,5600E+00	5,0000E+04	1,5700E+00	5,3000E+04	1,6250E+00	5,5000E+04	1,6400E+00
276	5,7000E+04	1,6300E+00	5,7239E+04	1,6280E+00	5,8000E+04	1,6230E+00	6,0000E+04	1,6178E+00	6,3000E+04	1,6140E+00
281	6,5000E+04	1,6130E+00	6,7000E+04	1,6100E+00	7,0000E+04	1,6180E+00	7,5000E+04	1,6730E+00	7,6319E+04	1,6230E+00
286	8,0000E+04	1,5730E+00	8,5000E+04	1,5555E+00	9,0000E+04	1,5577E+00	9,5000E+04	1,5716E+00	1,0000E+05	1,5800E+00
291	1,2000E+05	1,5810E+00	1,3500E+05	1,5499E+00	1,4000E+05	1,5386E+00	1,5000E+05	1,5162E+00	1,6000E+05	1,4988E+00
296	1,6469E+05	1,4937E+00	1,8000E+05	1,4856E+00	1,9300E+05	1,4823E+00	1,9381E+05	1,4821E+00	2,0000E+05	1,4818E+00
301	2,1500E+05	1,4820E+00	2,2000E+05	1,4830E+00	2,2500E+05	1,4840E+00	2,4000E+05	1,4860E+00	2,5000E+05	1,4915E+00
306	2,6000E+05	1,4970E+00	2,8000E+05	1,5070E+00	2,8720E+05	1,5130E+00	3,0000E+05	1,5200E+00	3,2000E+05	1,5310E+00
311	3,2500E+05	1,5340E+00	3,3139E+05	1,5375E+00	3,4000E+05	1,5410E+00	3,5000E+05	1,5450E+00	3,6000E+05	1,5500E+00
316	3,8000E+05	1,5575E+00	3,8963E+05	1,5600E+00	3,9365E+05	1,5620E+00	4,0000E+05	1,5640E+00	4,2000E+05	1,5693E+00
321	4,3000E+05	1,5720E+00	4,3582E+05	1,5736E+00	4,4000E+05	1,5741E+00	4,5000E+05	1,5760E+00	4,6000E+05	1,5778E+00
326	4,6300E+05	1,5780E+00	4,7197E+05	1,5795E+00	4,8000E+05	1,5808E+00	4,8804E+05	1,5813E+00	4,9407E+05	1,5820E+00
331	5,0000E+05	1,5825E+00	5,0712E+05	1,5835E+00	5,1415E+05	1,5845E+00	5,2000E+05	1,5853E+00	5,4000E+05	1,5900E+00
336	5,5000E+05	1,5920E+00	5,5833E+05	1,5942E+00	5,6000E+05	1,5950E+00	5,8000E+05	1,6010E+00	6,0000E+05	1,6083E+00
341	6,2000E+05	1,6165E+00	6,4000E+05	1,6245E+00	6,5000E+05	1,6290E+00	6,6000E+05	1,6340E+00	6,7000E+05	1,6380E+00
346	6,8000E+05	1,6430E+00	7,0000E+05	1,6525E+00	7,2000E+05	1,6620E+00	7,3000E+05	1,6672E+00	7,3305E+05	1,6695E+00
351	7,4000E+05	1,6720E+00	7,5000E+05	1,6775E+00	7,6318E+05	1,6850E+00	7,7000E+05	1,6879E+00	7,8000E+05	1,6930E+00
356	8,0000E+05	1,6989E+00	8,0334E+05	1,6993E+00	8,2000E+05	1,6994E+00	8,4000E+05	1,6940E+00	8,5000E+05	1,6910E+00
361	8,5255E+05	1,6905E+00	8,6000E+05	1,6893E+00	8,8000E+05	1,6889E+00	9,0000E+05	1,6905E+00	9,2000E+05	1,6950E+00
366	9,4000E+05	1,7018E+00	9,5000E+05	1,7052E+00	9,6000E+05	1,7085E+00	9,7000E+05	1,7108E+00	9,8000E+05	1,7144E+00
371	1,0000E+06	1,7190E+00	1,0042E+06	1,7200E+00	1,1000E+06	1,7500E+00	1,2000E+06	1,7860E+00	1,3000E+06	1,8200E+00
376	1,4000E+06	1,8550E+00	1,5000E+06	1,8900E+00	1,6000E+06	1,9110E+00	1,7000E+06	1,9270E+00	1,8000E+06	1,9400E+00
381	1,9000E+06	1,9510E+00	2,0000E+06	1,9560E+00	2,1000E+06	1,9600E+00	2,2000E+06	1,9600E+00	2,3000E+06	1,9560E+00
386	2,4000E+06	1,9420E+00	2,5000E+06	1,9220E+00	2,6000E+06	1,9070E+00	2,7000E+06	1,8930E+00	2,8000E+06	1,8800E+00
391	2,9000E+06	1,8690E+00	3,0000E+06	1,8600E+00	3,1000E+06	1,8490E+00	3,2000E+06	1,8380E+00	3,3000E+06	1,8270E+00
396	3,4000E+06	1,8160E+00	3,5000E+06	1,8070E+00	3,6000E+06	1,7980E+00	3,7000E+06	1,7900E+00	3,8000E+06	1,7820E+00
401	3,9000E+06	1,7750E+00	4,0000E+06	1,7680E+00	4,1000E+06	1,7600E+00	4,2000E+06	1,7520E+00	4,3000E+06	1,7460E+00
406	4,4000E+06	1,7390E+00	4,5000E+06	1,7320E+00	4,6000E+06	1,7250E+00	4,7000E+06	1,7190E+00	4,8000E+06	1,7130E+00
411	4,9000E+06	1,7080E+00	5,0000E+06	1,7040E+00	5,1000E+06	1,7000E+00	5,2000E+06	1,6960E+00	5,3000E+06	1,6920E+00
416	5,4000E+06	1,6890E+00	5,5000E+06	1,6870E+00	5,6000E+06	1,6860E+00	5,6797E+06	1,6860E+00	5,7000E+06	1,6880E+00
421	5,8000E+06	1,6920E+00	5,9000E+06	1,7040E+00	6,0000E+06	1,7290E+00	6,1000E+06	1,7680E+00	6,2000E+06	1,8160E+00
426	6,3000E+06	1,8640E+00	6,4000E+06	1,9100E+00	6,5000E+06	1,9540E+00	6,6000E+06	1,9970E+00	6,7000E+06	2,0390E+00
431	6,8000E+06	2,0820E+00	6,9000E+06	2,1190E+00	7,0000E+06	2,1530E+00	7,2000E+06	2,2030E+00	7,4000E+06	2,2460E+00
436	7,6000E+06	2,2790E+00	7,8000E+06	2,3100E+00	8,0000E+06	2,3310E+00	8,2000E+06	2,3510E+00	8,4000E+06	2,3660E+00
441	8,6000E+06	2,3750E+00	8,8000E+06	2,3820E+00	9,0000E+06	2,3850E+00	9,2000E+06	2,3840E+00	9,4000E+06	2,3780E+00
446	9,6000E+06	2,3690E+00	9,8000E+06	2,3580E+00	1,0000E+07	2,3460E+00	1,0500E+07	2,3210E+00	1,1000E+07	2,3040E+00
451	1,1500E+07	2,2990E+00	1,2000E+07	2,2970E+00	1,2500E+07	2,2960E+00	1,2707E+07	2,2960E+00	1,3000E+07	2,3360E+00
456	1,3500E+07	2,4610E+00	1,4000E+07	2,5380E+00	1,4500E+07	2,5870E+00	1,5000E+07	2,6210E+00	1,5500E+07	2,6370E+00
461	1,6000E+07	2,6380E+00	1,6500E+07	2,6100E+00	1,7000E+07	2,5600E+00	1,7500E+07	2,5100E+00	1,8000E+07	2,4720E+00
466	1,8500E+07	2,4570E+00	1,8591E+07	2,4570E+00	1,9000E+07	2,4590E+00	1,9500E+07	2,4670E+00	2,0000E+07	2,4800E+00


239 94 Pu σnf
73 SAC Bl
72 GEL De
71 ORL Gw
71 CAD Sz
70 CAD Sz
68 SAC Bl
68 HAR Pa
67 DUB Ry
66 IBJ Cz
66 LAS Sh
64 CCP Du
62 CCP Sm
61 ALD Ad
58 ANL Bo
58 CRC Bi
58 HAN Se
58 HAN Se
58 CCP Ka
57 LAS Sm
57 LAS He
57 HAN Le
57 HAR Al
56 ANL Co
56 HAN Le
56 HAN Le
56 HAR Ri
56 SAC Ne
56 HAR Ut
55 SAC Au
55 CCP Ad
51 CRC Tu
50 LAS Ny
σ(b)
En(eV)

REFERENCES FOR EXPERIMENTAL DATA

^{239}Pu(n,f)

Yr.	Lab	Author	References
73	SAC	Blons	Nuc. Sci. &Eng. 51, 130 (1973)
72	GEL	Deruytter, et al.	J. Nuc. En. 26, 293 (1972)
71	ORL	Gwin, et al.	Nuc. Sci. &Eng. 45, 25 (1971)
71	CAD	Szabo, et al.	Third Conf. Neutron Cross Sections & Tech., Knoxville, Tenn. Vol II, 573 (1971)
70	CAD	Szabo	Neutron Standards & Flux Normalization Conf. p.257, ANL (1970)
68	SAC	Blons, et al.	Comp. Rend. 267, 901 (1968)
68	HAR	Patrick, et al.	EANDC-(UK) 96 (1968)
67	DUB	Ryabov, et al.	Yad. Fiz 5, 925 (1967)
66	IBJ	Czyzewski	INR 688 (1966)
66	LAS	Shunk, et al.	Conf. Neutron Cross Sect. & Tech. Washington D.C. 2, 979 (1966)
64	CCP	Dubrovena, et al.	Dok. 157, 561 (1964)
62	CCP	Smirenkin, et al.	At. En. 13, 366, (1962)
61	ALD	Adams, et al.	J. Nuc. En. 14, 85 (1961)
58	ANL	Bollinger, et al.	Second Peaceful Uses of At. En. Conf. Geneva Vol 15, 127 (1958)
58	CRC	Bigham	Second Peaceful Uses of At. En. Conf. Geneva Vol 16, 125 (1958)
58	CCP	Kalanin, et al.	Second Peaceful Uses of At. En. Conf. Geneva Vol 16, 136 (1958)
58	HAN	Seppi, et al.	HW 55879, 3 (1958)
57	LAS	Smith, et al.	Bull. Am. Phys. Soc. 2, 196 (1957)
57	LAS	Henkel	LA-2114 (1957)
57	HAN	Leonard, et al.	HW-48893, 98 (1957)

REFERENCES FOR EXPERIMENTAL DATA

^{239}Pu(n,f) cont'd

Yr.	Lab	Author	References
57	HAR	Allen, et al.	Proc. Phys. Soc./A 70, 573 (1957)
56	ANL	Coté, et al.	Bull. Am. Phys. Soc. 1, 187 (1956)
56	HAN	Leonard	Priv. Comm. (1956)
56	HAR	Richmond, et al.	J. Nuc.En. 2, 177 (1956)
56	SAC	Netter, et al.	J. Phys. Rad. 17, 565 (1956)
56	HAR	Uttley	AERE NP/R-1996 (1956)
55	SAC	Auclair	Int. Peaceful Uses of At. En. Conf. Geneva Vol IV, 235 (1955)
55	CCP	Adamchuk	Int. Peaceful Uses of At. En. Conf. Geneva Vol IV, 216 (1955)
51	CRC	Tunnicliffe	CRGP-458 (1951)
50	LAS	Nyer	LAMS-938 (1950)

APPENDIX I

Derived Parameters Compared With Integral Measurements

Isotope/Reaction	Resonance Integral (barns) Dosimetry File	BNL-325*	U^{235} Fission Spectrum Average Dosimetry File (T=1.32) (mb)	FABRY** (mb)
^{6}Li(n,total He)	425.87		486.0	
^{10}B(n,total He)	1722.17	1722 ± 5	512.3	
^{23}Na(n,γ)	0.346	0.311 ± 0.010	0.291	
^{27}Al(n,p)			4.222	4.0 ± 0.4
^{27}Al(n,α)			0.801	0.73 ± 0.02
^{32}S(n,p)			63.87	69 ± 2
^{45}Sc(n,γ)	11.29	11.3 ± 1.0	5.879	
^{46}Ti(n,p)			10.24	12 ± 0.3
^{47}Ti(n,p)			21.40	20.0 ± 2.0
^{48}Ti(n,p)			0.194	0.32 ± 0.02
^{55}Mn(n,2n)			0.367	0.25 ± 0.01
^{54}Fe(n,p)			77.67	82.5 ± 2.0
^{56}Fe(n,p)			1.145	1.07 ± 0.06
^{58}Fe(n,γ)	1.58	1.19 ± 0.07	1.695	
^{59}Co(n,2n)			0.262	
^{59}Co(n,γ)	76.67	75.5 ± 1.5	6.433	
^{59}Co(n,α)			0.168	0.156 ± 0.006

*S.F. Mughabghab and D.I. Garber, Neutron Cross Sections, Vol. 1. Resonance Parameters, BNL-325, Brookhaven National Laboratory (1973).

**A. Fabry, "Evaluation of Microscopic Integral Cross Sections Averaged in a ^{235}U Thermal Fission Neutron Spectrum (for 29 Nuclear Reaction Relevant to Neutron Dosimetry and Fast Reactor Technology)," BLG-465, Centre d'Etude de l'Energie Nucleaire (1972).

†All cross sections in this column have been normalized to U^{235} (n,f) = 1250 (chosen by A. Fabry. See reference above.)

APPENDIX I (continued)

Derived Parameters Compared With Integral Measurements

Isotope/Reaction	Resonance Integral (barns) Dosimetry File	Resonance Integral (barns) BNL-325*	U^{235} Fission Spectrum Average Dosimetry File ($\bar{T}$=1.32) (mb)	U^{235} Fission Spectrum Average FABRY** (mb)
$^{58}Ni(n,2n)$			4.9×10^{-3}	
$^{58}Ni(n,p)$			101.5	113 ± 3
$^{60}Ni(n,p)$			2.658	
$^{63}Cu(n,\gamma)$	5.55	4.9 ± 0.4	11.01	10.1 ± 1.5
$^{63}Cu(n,\alpha)$			0.396	0.50 ± 0.05
$^{65}Cu(n,2n)$			0.464	
$^{115}In(n,n')$			166.8	188 ± 4
$^{115}In(n,\gamma)$	3242.74	3300 ± 100	136.6	146 ± 5
$^{127}I(n,2n)$			1.368	109 ± 0.05
$^{197}Au(n,\gamma)$	1564.70	1560 ± 40	84.92	88 ± 5
$^{232}Th(n,f)$			69.01	83.0 ± 3.5
$^{232}Th(n,\gamma)$	85.58	85 ± 3	103.8	
$^{235}U(n,f)$	282.00	275 ± 5	1243.2	1250†
$^{238}U(n,f)$			295.4	328 ± 10
$^{238}U(n,\gamma)$	277.53	275 ± 5	75.60	
$^{237}Np(n,f)$			1322.8	1370 ± 75
$^{239}Pu(n,f)$	303.90	301 ± 10	1782.4	1859 ± 60

*S.F. Mughabghab and D.I. Garber, Neutron Cross Sections, Vol. 1. Resonance Parameters, BNL-325, Brookhaven National Laboratory (1973).

**A. Fabry, "Evaluation of Microscopic Integral Cross Sections Averaged in a ^{235}U Thermal Fission Neutron Spectrum (for 29 Nuclear Reaction Relevant to Neutron Dosimetry and Fast Reactor Technology)," BLG-465, Centre d'Etude de l'Energie Nucleaire (1972).

†All cross sections in this column have been normalized to U^{235} (n,f) = 1250 (chosen by A. Fabry. See reference above.)