IAEA-NDS-41

Rev. 0

INTERNATIONAL ATOMIC ENERGY AGENCY

NUCLEAR DATA SERVICES

DOCUMENTATION SERIES OF THE IAEA NUCLEAR DATA SECTION

The International Reactor Dosimetry File (IRDF-82)

Assembled by

D.E. Cullen
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and
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Abstract

This document describes the contents of the first version of the International Reactor Dosimetry File (IRDF-82), distributed by the Nuclear Data Section of the International Atomic Energy Agency.

January 1982

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I. Introduction

The 1982 version of the International Reactor Dosimetry File (IRDF-82) is composed of two different parts. The first part is made up of a collection of Dosimetry cross sections and the second part contains a collection of benchmark spectra. For ease of use in Dosimetry applications both cross sections and spectra are distributed in multigroup (as opposed to continuous energy) form. Each of these two parts is in the ENDF/B-V format [1] as a separate computer file.

II. Dosimetry Cross Sections

The IRDF-82 Dosimetry cross section library contains the following data,

(1.) The entire ENDF/B-V Dosimetry Library (Mod. 1) as created at Brookhaven National Laboratory [2] in the form of 620 group averaged cross sections, using the SAND-II (3) group structure.

(2.) The reactions $^{19}F(n,2n)$, $^{24}Mg(n,p)$, $^{31}P(n,p)$, $^{29}Cu(n,2n)$, $^{64}Zn(n,p)$, $^{90}Zr(n,2n)$, $^{93}Nb(n,n')$ and $^{103}Rh(n,n')$, supplied by Vonach [4]. This data was converted to the ENDF/B-V format, [5] which in turn was converted to 620 group (SAND-II) form [6] at the Nuclear Data Section.

(3.) The reaction $^{23}Na(n,2n)$ provided by Marcinkowski [7]. This data was converted to the ENDF/B-V format [5] and then converted to 620 group (SAND-II) format [6] at the Nuclear Data Section.

(4.) The reaction $^{241}Am(n,f)$ as supplied by Patrick [8]. This data was converted to the ENDF/B-V format at Stuttgart [9] and then converted to 620 group (SAND-II) form [6] at the Nuclear Data Section.

(5.) ASTM and EUR standards damage cross sections for iron as provided by Zijp [10] in the form of 620 group (SAND-II) cross sections. This data was converted to the ENDF/B-V format at the Nuclear Data Section.

With the exception of the $^{241}Am(n,f)$ and the two damage cross sections, all other reactions have accompanying uncertainty information.

All of this data is presented in the standard ENDF/B-V format [1]. However, since ENDF/B-V does not have an MT [2] number corresponding to damage cross sections the convention was arbitrarily introduced to define two new MT numbers (see: ref. 1 for a definition of MT numbers).

MT = 800 - ASTM iron damage
= 801 - EUR iron damage.

See section V for a complete list of materials with dosimetry cross sections in the IRDF-82 library and section VI for a complete list of reactions in IRDF-82. Spectra average cross sections are presented in section VII, comparison to ^{252}Cf and ^{235}U experimentally measured spectra averages are presented in section VIII and plots of all cross sections in section IX.

III. Benchmark Spectra

The IRDF-82 Benchmark Spectra library contains ten benchmark spectra including,

(1.) The NBS ^{252}Cf spontaneous fission; the NBS ^{235}U and ENDF/B-V ^{235}U thermal fission, the Intermediate-Energy Standard Neutron Field (ISNF), the Coupled Fast Reactivity Measurement Facility (CFRMF), the 10 % Enriched Uranium Cylindrical Critical Assembly (BIG-TEN) and the Coupled Thermal/Fast Uranium and Boron Carbide Spherical Assembly (SIGMA-SIGMA) spectra, all of which were provided by Eisenhauer [11] in 620 group (SAND-II) form.

(2.) The ORR and YAYOI spectra, which were provided by Greenwood [12] in 100 group form.

(3.) The Central Zone Flux of the NEACRP Benchmark Spectra provided by Goel [13] in 208 group form.

All spectra are presented without uncertainty information.

All of these spectra were converted to the ENDF/B-V format at the Nuclear Data Section. In an attempt to simplify later processing and use of this data each spectrum is presented in the ENDF/B-V [1] format as section MF=3, MT=1 of a separate material (MAT). The spectra are presented in the form of group averages (not group integrals). If for any application group integrals are required, each group average may be converted to a group integral over the same group by simply multiplying by the width of the group.

See section VII for spectra averaged cross sections, section VIII for comparison to experimentally measured spectra averages and section X for plots of each spectra. For each spectra two plots are presented; first a plot using log-log scaling (which is convenient for checking and seeing general trends in the spectra), and next a plot using log-linear scaling (which is convenient for use in visualizing which energy ranges are important for each spectrum).

IV. References

[1] GARBER, D., et al., Data Formats and Procedures for the Evaluated Nuclear Data File, ENDF, BNL-NCS-50496 (ENDF-102), Brookhaven (1975).

[2] MAGURNO, B.: Private Communication, Brookhaven (1981).

[3] SIMONS, R.L. and MCELROY, W.M.: Evaluated Reference Cross Section Libraries", BNWL-1312, Richland (1970).

[4] TAGESEN, S., VONACH, H., and STROHMAIER, B., Physics Data - Nr. 13-1 (1979) and No. 13-2 (1980), Vienna.

[5] PRONYAEV, V., and SCHWERER, O., Private Communication, IAEA, Vienna (1981).

[6] CULLEN, D.E., Program GROUPIE (Version 79-1): Calculation of Bondarenko self-shielded cross sections and multiband parameters from data in the ENDF/B format", UCRL-50400, Vol. 17, part D, Livermore (1980).

[7] MARCINKOWSKI, Private Communication, Warsaw, (1980).

[8] PATRICK, B., AERE-R-8528, Harwell (1979).

[9] MATTES, M., Private Communication, Stuttgart (1981).

[10] ZIJP, W.L., Private Communication, Petten (1981).

[11] EISENHAUER, C., Private Communication, National Bureau of Standards, Washington (1980).

[12] GREENWOOD, L., Private Communication, Argonne, (1981).

[13] GOEL, B., Private Communication, Karlsruhe (1981).

V. INDF-82
Cross Sections
Table of Contents
by Material

Z El A	MAT NO.	SPECIFICATION	LAB	DATE	AUTHOR	REFERENCE
3-Li- 6g	6424	Neutron + error files	LASL	DEC78	L.STEWART, G.HALE, P.YOUNG	
5-B - 10g	6425	Neutron + error files	LASL	JAN79	L.STEWART, G.HALE, P.YOUNG	
9-F - 19g	920	Neutron + error files	AUSBIRK	79	S.TAGESEN,H.VONACH,B.STROHMAIER	FIN.REP.ON RC,80
11-Na- 23g	1120	Neutron + error files	FOLIB.I	FEB79	ADAMSKI, HERMAN AND MARCINKOWSKI	R,INR-1809,9,79
11-Na- 23g	6311	Neutron (RP) + error files	ORNL	DEC77	D.C.LARSON	
12-Mg- 24g	1220	Neutron + error files	AUSBIRK	79	S.TAGESEN,H.VONACH,B.STROHMAIER	B,FH-DAT,13-1,79
13-Al- 27g	6313	Neutron + error files	LASL	DEC73	P.G. YOUNG, D.G. FOSTER, JR.	LA-4726 (1973).
15-P - 31g	1520	Neutron + error files	AUSBIRK	79	S.TAGESEN,H.VONACH,B.STROHMAIER	FIN.REP.ON RC,80
16-S - 32g	6439	Neutron + error files	BNL	APR79	DIVADEENAM	
21-Sc- 45g	6426	Neutron (RP) + error files	BNL	JUL79	MAGURNO AND MUGHABGHAB	
22-Ti- 46g	6427	Neutron + error files	ANL	JAN77	C.PHILIS,O.BERSILLON,D.SMITH,ETC.	
22-Ti- 47g	6428	Neutron + error files	ANL	JAN77	C.PHILIS,O.BERSILLON,D.SMITH,ETC	
22-Ti- 48g	6429	Neutron + error files	ANL	JAN77	C.PHILIS,O.BERSILLON,D.SMITH ETC.	
25-Mn- 55g	6325	Neutron + error files	BNL	MAR77	S.F. MUGHABGHAB	
26-Fe- 0g	8000	Neutron cross sections only	FETTEN	79	W.L.ZIJP	PRIVATE COM.
26-Fe- 0g	8001	Neutron cross sections only	FETTEN	79	W.L.ZIJP	PRIVATE COM.
26-Fe- 54g	6430	Neutron + error files	HEDL	JUN79	R.SCHENTER F.SCHMITTROTH F.MANN	
26-Fe- 56g	6431	Neutron + error files	ORNL	JUL78	C.Y.FU	
26-Fe- 58g	6432	Neutron (RP) + error files	HEDL	JUN79	R.SCHENTER F.SCHMITTROTH F.MANN	
27-Co- 59g	6327	Neutron (RP) + error files	BNL	JUN77	S.MUGHABGHAB	
28-Ni- 58g	6433	Neutron + error files	BNL	MAR77	M.DIVADEENAM	
28-Ni- 60g	6434	Neutron + error files	BNL	MAR77	M.DIVADEENAM	
29-Cu- 63g	2920	Neutron + error files	AUSBIRK	79	S.TAGESEN,H.VONACH,B.STROHMAIER	B,FH-DAT,13-1,79
29-Cu- 63g	6435	Neutron (RP) + error files	ORNL	JUL78	C.Y.FU	
29-Cu- 65g	6436	Neutron + error files	ORNL	JUL78	C.Y.FU	
30-Zn- 64g	3020	Neutron + error files	AUSBIRK	79	S.TAGESEN,H.VONACH,B.STROHMAIER	B,FH-DAT,13-1,79
40-Zr- 90g	4020	Neutron + error files	AUSBIRK	79	S.TAGESEN,H.VONACH,B.STROHMAIER	B,FH-DAT,13-1,79
41-Nb- 93g	4120	Neutron + error files	AUSBIRK	79	S.TAGESEN,H.VONACH,B.STROHMAIER	FIN.REP.ON RC,80
45-Rh-103g	4520	Neutron + error files	AUSBIRK	79	S.TAGESEN,H.VONACH,B.STROHMAIER	FIN.REP.ON RC,80
49-In-115g	6437	Neutron (RP) + error files	HEDL/ANL	JAN78	F.SCHMITTROTH,D.L.SMITH	
53-I -127g	6438	Neutron + error files	STANFORD	AUG72	R.SHER	
79-Au-197g	6379	Neutron (RP) + error files	BNL	FEB77	S.F.MUGHABGHAB	
90-Th-232g	6390	Neutron (RP) + error files	BNL	DEC77	DHAT,SMITH,LEONARD,DEBAUSSUREETAL	
92-U -235g	6395	Neutron (RP) + error files	BNL	APR77	M.R.BHAT	
92-U -238g	6398	Neutron (RP) + error files	ANL+	JUN77	E.FENNINGTON,A.SMITH,W.POENITZ	ANL/NDM-32
93-Np-237g	6337	Neutron (RP) + error files	HEDL,SRL,+	APR78	HANN,BEN.HAMIN,SMITH,STEIN,REICH,+	HEDL THE 77-54
94-Pu-239g	6399	Neutron (RP) + error files	GE-FBRD	OCT76	E.KUJAWSKI,L.STEWART(LASL)	
95-Am-241g	1009	Neutron cross sections only	AERE	79	J.E.LYNN,B.H.PATRICK,M.G.SOWERBY+	AERE-R 8528

VI. IRDF-82
Cross Sections
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by Reaction

3-Li- 6g	Mat.No: 6424	Lab: LASL	
	Date: DEC78	Author: L.STEWART, G.HALF, P.YOUNG	
	Ref:	Card images: 323	
	File Type	Reaction Type	Q-value
	General Information	Descriptive data and Dictionary	
	Resonance parameter data	Resonance information	
	Neutron cross sections	Total ^{4}He production	4.78380+ 6
	Data covariance matrices for neutron X-sections	Total ^{4}He production	4.78380+ 6
5-B - 10g	Mat.No: 6425	Lab: LASL	
	Date: JAN79	Author: L.STEWART, G.HALE, P.YOUNG	
	Ref:	Card images: 320	
	File Type	Reaction Type	Q-value
	General Information	Descriptive data and Dictionary	
	Resonance parameter data	Resonance information	
	Neutron cross sections	Total ^{4}He production	2.75000+ 6
	Data covariance matrices for neutron X-sections	Total ^{4}He production	2.75000+ 6
9-F - 19g	Mat.No: 920	Lab: JAUSIRK	
	Date: 79	Author: S.TAGESEN,H.VONACH,E.STROHMAIER	
	Ref: FIN.REP.ON RC,80	Card images: 102	
	File Type	Reaction Type	Q-value
	General Information	Descriptive data and Dictionary	
	Neutron cross sections	direct (n,2n) cross section	-1.04270+ 7
	Data covariance matrices for neutron X-sections	direct (n,2n) cross section	-1.04270+ 7
11-Na- 23g	Mat.No: 1120	Lab: JPOLIBJ	
	Date: FEB79	Author: ADAMSKI, HERMAN AND MARCINKOWSKI	
	Ref: ,INR-1609,9,79	Card images: 82	
	File Type	Reaction Type	Q-value
	General Information	Descriptive data and Dictionary	
	Neutron cross sections	direct (n,2n) cross section	-1.24100+ 7
	Data covariance matrices for neutron X-sections	direct (n,2n) cross section	-1.24100+ 7

11-Na- 23g	Mat.No: 6311 Date: DEC77 Ref:	Lab: ORNL Author: D.C.LARSON Card images: 364		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		(n,γ) radiative capture cross section	6.96150+ 6
	Data covariance matrices for resonance parameters		Resonance information	
	Data covariance matrices for neutron X-sections		(n,γ) radiative capture cross section	6.96150+ 6
12-Mg- 24g	Mat.No: 1220 Date: 79 Ref: B,PH-DAT,13-1,79	Lab: JAUSIRK Author: E.TAGESEN,H.VONACH,B.STROHMAIER Card images: 277		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Neutron cross sections		(n,p) cross section	-4.73100+ 6
	Data covariance matrices for neutron X-sections		(n,p) cross section	-4.73100+ 6
13-Al- 27g	Mat.No: 6313 Date: DEC73 Ref: LA-4726 (1973).	Lab: LASL Author: P.G. YOUNG, D.G. FOSTER, JR. Card images: 521		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		(n,p) cross section (n,α) cross section	-1.82780+ 6 -3.13160+ 6
	Data covariance matrices for neutron X-sections		(n,p) cross section (n,α) cross section	-1.82780+ 6 -3.13160+ 6

15-P - 31g	Mat.No: 1520 Date: 79 Ref: FIN.REF.CN RC,80	Lab: 3AUSIRK Author: S.TAGESEN,H.VONACH,B.STROHMAIER Card images: 19E		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Neutron cross sections		(n,p) cross section	-7.07000+ 6
	Data covariance matrices for neutron X-sections		(n,p) cross section	-7.07000+ 6
16-S - 32g	Mat.No: 6439 Date: APR79 Ref:	Lab: BNL Author: DIVADEENAM Card images: 26E		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		(n,p) cross section	-9.27500+ 6
	Data covariance matrices for neutron X-sections		(n,p) cross section	-9.27500+ 6
21-Sc- 45g	Mat.No: 6426 Date: JUL79 Ref:	Lab: BNL Author: MAGURNO AND MUGHABGHAB Card images: 47D		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		(n,γ) radiative capture cross section	
	Data covariance matrices for neutron X-sections		(n,γ) radiative capture cross section	

22-Ti- 46g	Mat.No: 6427 Date: JAN77 Ref:	Lab: ANL Author: C.PHILIS,C.BERSILLON,D.SMITH,ETC. Card Images: 281		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		(n,p) cross section	-1.58490+ 6
	Data covariance matrices for neutron X-sections		(n,p) cross section	-1.58490+ 6
22-Ti- 47g	Mat.No: 6428 Date: JAN77 Ref:	Lab: ANL Author: C.PHILIS,C.BERSILLON,D.SMITH.ETC Card Images: 474		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance Information	
	Neutron cross sections		(n,n'p) cross section (n,p) cross section	-1.04600+ 7 3.18710+ 6
	Data covariance matrices for neutron X-sections		(n,n'p) cross section (n,p) cross section	-1.04600+ 7 3.18710+ 6
22-Ti- 48g	Mat.No: 6429 Date: JAN77 Ref:	Lab: ANL Author: C.PHILIS,C.BERSILLON,C.SMITH ETC. Card Images: 476		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		(n,n'p) cross section (n,p) cross section	-1.14460+ 7 -3.20800+ 6
	Data covariance matrices for neutron X-sections		(n,n'p) cross section (n,p) cross section	-1.14460+ 7 -3.20800+ 6

25-Mn- 55g	Mat.No: 6325	Lab: BNL		
	Date: MAR77	Author: S.F. MUGHABGHAB		
	Ref:	Card images: 251		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		direct (n,2n) cross section	-1.02250+ 7
	Data covariance matrices for neutron X-sections		direct (n,2n) cross section	-1.02250+ 7
26-Fe- 0g	Mat.No: 8000	Lab: PETTEN		
	Date: 7	Author: W.L.ZIJP		
	Ref: PRIVATE COM.	Card images: 221		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Neutron cross sections		Damage (ASTM)	
26-Fe- 0g	Mat.No: 8001	Lab: PETTEN		
	Date: 7	Author: W.L.ZIJP		
	Ref: PRIVATE COM.	Card images: 221		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Neutron cross sections		Damage (EUR)	
26-Fe- 54g	Mat.No: 6430	Lab: HEDL		
	Date: JUN79	Author: R.SCHENTER F.SCHMITTROTH F.MANN		
	Ref:	Card images: 263		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		(n,p) cross section	8.53000+ 4
	Data covariance matrices for neutron X-sections		(n,p) cross section	8.53000+ 4

26-Fe- 56g	Mat.No: 6421 Date: JUL78 Ref:	Lab: ORNL Author: C.Y.FU Card images: 291		
	File Type	Reaction Type	Q-Value	
	General Information	Descriptive data and Dictionary		
	Resonance parameter data	Resonance information		
	Neutron cross sections	(n,p) cross section	-2.91300+ 6	
	Data covariance matrices for neutron X-sections	(n,p) cross section	-2.91300+ 6	
26-Fe- 58g	Mat.No: 6432 Date: JUN79 Ref:	Lab: HEDL Author: R.SCHENTER F.SCHMITTROTH F.MANN Card images: 348		
	File Type	Reaction Type	Q-Value	
	General Information	Descriptive data and Dictionary		
	Resonance parameter data	Resonance information		
	Neutron cross sections	(n,γ) radiative capture cross section	6.58660+ 6	
	Data covariance matrices for resonance parameters	Resonance information		
	Data covariance matrices for neutron X-sections	(n,γ) radiative capture cross section	6.58660+ 6	
27-Co- 59g	Mat.No: 6327 Date: JUN77 Ref:	Lab: BNL Author: S.MUGHABGHAB Card images: 941		
	File Type	Reaction Type	Q-Value	
	General Information	Descriptive data and Dictionary		
	Resonance parameter data	Resonance information		
	Neutron cross sections	direct (n,2n) cross section	-1.04610+ 7	
		(n,γ) radiative capture cross section	7.49000+ 6	
		(n,α) cross section	3.17800+ 5	
	Data covariance matrices for neutron X-sections	direct (n,2n) cross section	-1.04610+ 7	
		(n,γ) radiative capture cross section	7.49000+ 6	
		(n,α) cross section	3.17800+ 5	

28-Ni- 58g	Mat.No: 6433	Lab: BNL	
	Date: MAR77	Author: M.DIVADEENAM	
	Ref:	Card images: 511	
	File Type	**Reaction Type**	**Q-Value**
	General Information	Descriptive data and Dictionary	
	Resonance parameter data	Resonance information	
	Neutron cross sections	direct (n,2n) cross section	-1.22030+ 7
		(n,p) cross section	3.94700+ 6
	Data covariance matrices for neutron X-sections	direct (n,2n) cross section	-1.22030+ 7
		(n,p) cross section	3.94700+ 6
28-Ni- 60g	Mat.No: 6434	Lab: BNL	
	Date: MAR77	Author: M.DIVADEENAM	
	Ref:	Card images: 256	
	File Type	**Reaction Type**	**Q-Value**
	General Information	Descriptive data and Dictionary	
	Resonance parameter data	Resonance information	
	Neutron cross sections	(n,p) cross section	-2.04110+ 6
	Data covariance matrices for neutron X-sections	(n,p) cross section	-2.04110+ 6
29-Cu- 63g	Mat.No: 2920	Lab: JAUSIRK	
	Date: 79	Author: S.TAGESEN,H.VONACH,B.STROHMAIER	
	Ref: R,PH-DAT,13-1,79	Card images: 157	
	File Type	**Reaction Type**	**Q-Value**
	General Information	Descriptive data and Dictionary	
	Neutron cross sections	direct (n,2n) cross section	-1.08600+ 7
	Data covariance matrices for neutron X-sections	direct (n,2n) cross section	-1.08500+ 7

29-Cu- 63g	Mat.No: 6425 Date: JUL78 Ref:	Lab: ORNL Author: C.Y.FU Card Images: 671		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		(n,γ) radiative capture cross section (n,α) cross section	7.91590+ 6 1.71490+ 6
	Data covariance matrices for resonance parameters		Resonance information	
	Data covariance matrices for neutron X-sections		(n,γ) radiative capture cross section (n,α) cross section	7.91590+ 6 1.71490+ 6
29-Cu- 65g	Mat.No: 6426 Date: JUL78 Ref:	Lab: ORNL Author: C.Y.FU Card Images: 286		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		direct (n,2n) cross section	-9.91000+ 6
	Data covariance matrices for neutron X-sections		direct (n,2n) cross section	-9.91000+ 6
30-Zn- 64g	Mat.No: 3020 Date: 79 Ref: P,PH-DAT,13-1,79	Lab: 3AUSIRK Author: B.TAGESEN,H.VONACH,B.STROHMAIER Card Images: 256		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Neutron cross sections		(n,p) cross section	-2.06700+ 6
	Data covariance matrices for neutron X-sections		(n,p) cross section	-2.06700+ 6

40-Zr- 90g	Mat.No: 4020 Date: 79 Ref: B,PH-DAT,13-1,79	Lab: 3AUSIRK Author: S.TAGESEN,H.VONACH,B.STROHMAIER Card images: 161		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Neutron cross sections		direct (n,2n) cross section	-1.19900+ 7
	Data covariance matrices for neutron X-sections		direct (n,2n) cross section	-1.19900+ 7
41-Nb- 93g	Mat.No: 4120 Date: 79 Ref: FIN.REP.ON RC,80	Lab: 3AUSIRK Author: S.TAGESEN,H.VONACH,B.STROHMAIER Card images: 242		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Neutron cross sections		3.04000+ 4 Ev (n,n') Level	-3.04000+ 4
	Data covariance matrices for neutron X-sections		3.04000+ 4 Ev (n,n') Level	-3.04000+ 4
45-Rh-103g	Mat.No: 4520 Date: 79 Ref: FIN.REP.ON RC,80	Lab: 3AUSIRK Author: S.TAGESEN,H.VONACH,B.STROHMAIER Card images: 207		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Neutron cross sections		3.97500+ 4 Ev (n,n') Level	-3.97500+ 4
	Data covariance matrices for neutron X-sections		3.97500+ 4 Ev (n,n') Level	-3.97500+ 4
49-In-115g	Mat.No: 6437 Date: JAN78 Ref:	Lab: HEDL/ANL Author: F.SCHMITTROTH/D.L.SMITH Card images: 659		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		3.36000+ 5 Ev (n,n') Level (n,γ) radiative capture cross section	-3.36000+ 6 6.59800+ 6
	Data covariance matrices for neutron X-sections		3.36000+ 5 Ev (n,n') Level (n,γ) radiative capture cross section	-3.36000+ 6 6.59800+ 6

With the exception of the ^{241}Am(n,f) and the two damage cross sections, all other reactions have accompanying uncertainty information.

53-I -127g	Mat.No: 6438 Date: AUG72 Ref:	Lab: STANFORD Author: R.SHER Card images: 249		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		direct (n,2n) cross section	-9.15000+ 6
	Data covariance matrices for neutron X-sections		direct (n,2n) cross section	-9.15000+ 6
79-Au-197g	Mat.No: 6379 Date: FEB77 Ref:	Lab: BNL Author: S.F.MUGHABGHAB Card images: 664		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		(n,γ) radiative capture cross section	6.51270+ 6
	Data covariance matrices for neutron X-sections		(n,γ) radiative capture cross section	6.51270+ 6
90-Th-232g	Mat.No: 6390 Date: DEC77 Ref:	Lab: BNL Author: BHAT,SMITH,LECKARD,DESAUSSUREETAL Card images: 1142		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		Total fission cross section(sum of MT=19to21,38) (n,γ) radiative capture cross section	1.85210+ 8 4.78640+ 6
	Data covariance matrices for neutron X-sections		Total fission cross section(sum of MT=19to21,38) (n,γ) radiative capture cross section	1.85210+ 8 4.78640+ 6

are important for each spectrum).

92-U -235g	Mat.No: 6355	Lab: BNL	
	Date: APR77	Author: M.R.BHAT	
	Ref:	Card images: 1340	
	File Type	**Reaction Type**	**Q-Value**
	General Information	Descriptive data and Dictionary	
	Resonance parameter data	Resonance information	
	Neutron cross sections	Total fission cross section(sum of MT=19to21,38)	1.94020+ 8
	Data covariance matrices for neutron X-sections	Total fission cross section(sum of MT=19to21,38)	1.94020+ 8
92-U -238g	Mat.No: 6358	Lab: ANL+	
	Date: JUN77	Author: E.PENNINGTON,A.SMITH,B.POENITZ	
	Ref: ANL/NDM-32	Card images: 1192	
	File Type	**Reaction Type**	**Q-Value**
	General Information	Descriptive data and Dictionary	
	Resonance parameter data	Resonance information	
	Neutron cross sections	Total fission cross section(sum of MT=19to21,38)	1.98122+ 8
		(n,γ) radiative capture cross section	4.80440+ 6
	Data covariance matrices for neutron X-sections	Total fission cross section(sum of MT=19to21,38)	1.98122+ 8
		(n,γ) radiative capture cross section	4.80440+ 6
93-Np-237g	Mat.No: 6337	Lab: HEDL,SRL,+	
	Date: APR78	Author: MANN,BENJAMIN,SMITH,STEIN,REICH,+	
	Ref: HEDL TME 77-64	Card images: 1328	
	File Type	**Reaction Type**	**Q-Value**
	General Information	Descriptive data and Dictionary	
	Resonance parameter data	Resonance information	
	Neutron cross sections	Total fission cross section(sum of MT=19to21,38)	1.96100+ 8
	Data covariance matrices for resonance parameters	Resonance information	
	Data covariance matrices for neutron X-sections	Total fission cross section(sum of MT=19to21,38)	1.96100+ 8

94-Pu-239g	Mat.No: 6359 Date: OCT76 Ref:	Lab: GE-FBRD Author: E.KUJAWSKI,L.STEWART(LASL) Card Images: 957		
	File Type		Reaction Type	C-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		Total fission cross section(sum of MT=19to21,38)	2.00060+ 8
	Data covariance matrices for neutron X-sections		Total fission cross section(sum of MT=19to21,38)	2.00050+ 8
95-Am-241g	Mat.No: 1009 Date: 79 Ref:	Lab: AERE Author: J.E.LYNN,B.H.PATRICK,M.G.SOWERBY+ Card Images: 230		
	File Type		Reaction Type	C-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		Total fission cross section(sum of MT=19to21,38)	2.02300+ 8

VII. Spectra Averaged Cross Sections

In the following Table of Spectra Averaged Cross Sections the number of groups indicated for each reaction or spectrum is the number of groups in which the reaction or spectrum is non-zero. The threshold energy listed for each reaction is the lower energy boundary of the first group within which the cross section is non-zero, and as such is the effective threshold in the 620 group (SAND-II) representation. Similarly the energy range of each spectrum is the energy range over which the spectrum is non-zero. These conventions were used in an attempt to indicate the effective number of groups and energy ranges for each reaction and spectrum.

INTERNATIONAL REACTION DOSIMETRY FILE (IRDF-82) CROSS SECTIONS AND SPECTRA

	CF-252 FISS (NBS)	U-235 FISS (NBS)	U-235 FISS (ENDF/B-V)	INF (NBS)	CFRMF (IDAHO)
SPECTRUM					
NUMBER OF GROUPS	620	620	620	620	459
SPECTRUM ENERGY RANGE IS FROM	1.0000- 4	1.0000- 4	1.0000- 4	1.0000- 4	4.0000- 1
TO (EV)	1.0000+ 7	1.0000+ 7	1.0000+ 7	1.0000+ 7	1.0000+ 7
SPECTRUM AVERAGED ENERGY (EV)	2.1194+ 6	1.9771+ 6	2.0313+ 6	1.0071+ 6	7.4135+ 5

ISOTOPE	MAT	GROUPS	THRESHOLD (EV)	REACTION	SPECTRUM AVERAGED (BARNS)				
3-LI- 6	6424	620	1.000- 4	HELIUM PRODUCTION	4.6460- 1	4.6500- 1	4.5452- 1	7.9777- 1	9.1544- 1
5-B - 10	6425	620	1.000- 4	HELIUM PRODUCTION	4.6886- 1	4.9924- 1	4.9060- 1	1.7054+ 0	1.6752+ 0
9-F - 19	920	70	1.100+ 7	(N,2N)	1.5712- 5	4.6359- 6	6.4421- 6	1.0171- 6	2.0708- 6
11-NA- 23	1120	51	1.290+ 7	(N,2N)	6.4836- 6	2.4569- 6	2.3020- 6	6.6845- 7	9.7895- 7
11-NA- 23	6311	620	1.000- 4	(N,GAMMA)	2.7116- 4	2.8170- 4	2.7498- 4	1.9173- 3	1.5083- 3
12-MG- 24	1220	131	4.900+ 6	(N,P)	2.1578- 3	1.4535- 3	1.5073- 3	4.0756- 4	3.6436- 4
13-AL- 27	6313	162	1.800+ 6	(N,P)	5.1382- 3	4.1215- 3	4.2624- 3	1.2439- 3	9.4207- 4
13-AL- 27	6313	148	3.200+ 6	(N,ALPHA)	1.0588- 3	6.9337- 4	7.1943- 4	1.9392- 4	1.7639- 4
15-P - 31	1520	165	1.500+ 6	(N,P)	3.0437- 2	2.7397- 2	2.8540- 2	1.0137- 2	6.3510- 3
16-S - 32	6439	172	9.200+ 5	(N,P)	7.5999- 2	6.7609- 2	7.0494- 2	2.4256- 2	1.5484- 2
21-SC- 45	6424	620	1.000- 4	(N,GAMMA)	5.2698- 3	5.6398- 3	5.4471- 3	2.7773- 2	2.4414- 2
22-TI- 46	6427	154	1.600+ 6	(N,P)	1.3449- 2	1.0812- 2	1.1173- 2	3.2432- 3	2.4576- 3
22-TI- 47	6428	74	1.060+ 7	(N,N'P)	2.0423- 5	8.4489- 6	8.1654- 6	2.3144- 6	2.8943- 6
22-TI- 47	6428	620	1.000- 4	(N,P)	2.4065- 2	2.1589- 2	2.2458- 2	8.3019- 3	5.1317- 3
22-TI- 48	6429	64	1.160+ 7	(N,N'P)	3.4358- 6	1.3641- 6	1.3001- 6	3.7138- 7	4.9173- 7
22-TI- 48	6429	148	3.200+ 6	(N,P)	4.0912- 4	2.7268- 4	2.8170- 4	7.6416- 5	6.8272- 5
25-MN- 55	6325	74	1.040+ 7	(N,2N)	4.4027- 4	2.0164- 4	2.0114- 4	5.5366- 5	5.6360- 5
26-FE- 0	8060	620	1.000- 4	DAMAGE (ASTM)	8.9510+ 2	8.5415+ 2	8.7406+ 2	4.8778+ 2	3.8698+ 2
26-FE- 0	8001	620	1.000- 4	DAMAGE (EUR)	8.6642+ 2	8.3026+ 2	8.4945+ 2	4.8182+ 2	3.8161+ 2
26-FE- 54	6430	620	1.000- 4	(N,P)	8.8255- 2	7.7821- 2	8.1021- 2	2.7384- 2	1.7802- 2
26-FE- 56	6431	151	2.900+ 6	(N,P)	1.4144- 3	1.0056- 3	1.0344- 3	2.8561- 4	2.4420- 4
26-FE- 58	6432	620	1.000- 4	(N,GAMMA)	1.4605- 3	1.7122- 3	1.4874- 3	7.1988- 3	6.6418- 3
27-CO- 59	6327	74	1.060+ 7	(N,2N)	4.0494- 4	1.8292- 4	1.8179- 4	5.0212- 5	5.1605- 5
27-CO- 59	6327	620	1.000- 4	(N,GAMMA)	6.0278- 3	6.2781- 3	6.1738- 3	4.2951- 2	8.7271- 2
27-CO- 59	6327	125	5.500+ 6	(N,ALPHA)	2.1614- 4	1.4483- 4	1.4975- 4	4.0713- 5	3.6282- 5
28-NI- 58	6433	56	1.240+ 7	(N,2N)	7.2343- 6	2.8593- 6	2.7222- 6	7.8093- 7	1.0514- 6
28-NI- 58	6433	620	1.000- 4	(N,P)	1.1381- 1	1.0088- 1	1.0498- 1	3.6556- 2	2.3411- 2
28-NI- 60	6434	155	2.500+ 6	(N,P)	3.4422- 3	2.5282- 3	2.6077- 3	7.2564- 4	6.0329- 4
29-CU- 63	2920	48	1.120+ 7	(N,2N)	1.9282- 4	8.2463- 5	8.0633- 5	2.2896- 5	2.4408- 5
29-CU- 63	6435	620	1.000- 4	(N,GAMMA)	9.6494- 3	1.0076- 2	9.9402- 3	5.2679- 2	4.6422- 2
29-CU- 63	6435	163	1.700+ 6	(N,ALPHA)	7.5813- 4	5.4024- 4	5.5818- 4	1.5467- 4	1.3103- 4
29-CU- 65	6434	80	1.000+ 7	(N,2N)	6.4913- 4	3.0569- 4	3.0707- 4	8.3981- 5	8.5312- 5
30-ZN- 64	3020	171	9.600+ 5	(N,P)	3.9234- 2	3.4642- 2	3.6126- 2	1.2139- 2	7.9024- 3
40-ZR- 90	4020	59	1.210+ 7	(N,2N)	1.9773- 4	8.0081- 5	7.6911- 5	2.1900- 5	2.7505- 5
41-NB- 93	4120	209	1.350+ 5	(N,N') FIRST LEVEL	1.6160- 1	1.5526- 1	1.6016- 1	7.8908- 2	4.9375- 2
45-RH-103	4520	215	1.000+ 5	(N,N') FIRST LEVEL	7.1216- 1	6.8896- 1	7.0505- 1	3.8757- 1	2.7947- 1
49-IN-115	6437	193	3.200+ 5	(N,N') FIRST LEVEL	1.8192- 1	1.7338- 1	1.7925- 1	9.4013- 2	4.9592- 2
49-IN-115	6437	620	1.000- 4	(N,GAMMA)	1.2124- 1	1.2659- 1	1.2444- 1	2.8909- 1	2.8222- 1
53-I -127	6430	88	9.200+ 6	(N,2N)	2.3108- 3	1.1842- 3	1.2135- 3	3.2605- 4	3.2163- 4
79-AU-197	6379	620	1.000- 4	(N,GAMMA)	7.6324- 2	8.0744- 2	7.8270- 2	4.0347- 1	4.0266- 1
90-TH-232	6390	410	5.000+ 0	FISSION	7.8066- 2	7.2399- 2	7.5038- 2	3.2583- 2	1.8416- 2
90-TH-232	6390	620	1.000- 4	(N,GAMMA)	8.9674- 2	9.4219- 2	9.1950- 2	2.5743- 1	2.6330- 1
92-U -235	6395	620	1.000- 4	FISSION	1.2358+ 0	1.2360+ 0	1.2359+ 0	1.6141+ 0	1.5804+ 0
92-U -238	6398	620	1.000- 4	FISSION	3.1358- 1	2.9464- 1	3.0518- 1	1.3713- 1	7.7223- 2
92-U -238	6398	620	1.000- 4	(N,GAMMA)	4.8334- 2	7.2060- 2	7.0351- 2	2.2703- 1	2.3404- 1
93-NP-237	6337	620	1.000- 4	FISSION	1.3520+ 0	1.3219+ 0	1.3468+ 0	7.9257- 1	5.8541- 1
94-PU-239	6399	620	1.000- 4	FISSION	1.7918+ 0	1.7855+ 0	1.7910+ 0	1.8234+ 0	1.7872+ 0
95-AM-241	1009	620	1.000- 4	FISSION	1.4264+ 0	1.3819+ 0	1.4171+ 0	7.6305- 1	4.9229- 1

INTERNATIONAL REACTION DOSIMETRY FILE (IRDF-82) CROSS SECTIONS AND SPECTRA

SPECTRUM	BIG-TEN (LASL)	SIGMA-SIGMA (MOL)	ORR (ARGONNE)	YAYOI (ARGONNE)	NEACRP (KARLSRUHE)
NUMBER OF GROUPS	395	429	100	100	208
SPECTRUM ENERGY RANGE IS FROM	1.0000+ 1	4.0000- 1	1.0000- 4	1.0000- 4	1.4663- 2
TO (EV)	1.8000+ 7	1.5000+ 7	2.0000+ 7	2.0000+ 7	1.0500+ 7
SPECTRUM AVERAGED ENERGY (EV)	6.0221+ 5	7.6139+ 5	5.9629+ 5	1.3877+ 6	4.3223+ 5

ISOTOPE	MAT	GROUPS	THRESHOLD (EV)	REACTION	SPECTRUM AVERAGES (BARNS)				
3-LI- 6	6424	620	1.000- 4	HELIUM PRODUCTION	8.8788- 1	8.6618- 1	2.1130+ 2	5.9875- 1	1.0775+ 0
5-B - 10	6425	620	1.000- 4	HELIUM PRODUCTION	1.1925+ 0	1.4810+ 0	8.6519+ 2	6.7198- 1	2.6701+ 0
9-F - 19	920	70	1.100+ 7	(N,2N)	1.8106- 6	1.1025- 6	4.0871- 6	9.0789- 6	0.0 + 0
11-NA- 23	1120	51	1.290+ 7	(N,2N)	7.3059- 7	2.2842- 7	2.2708- 6	4.4317- 6	0.0 + 0
11-NA- 23	6311	620	1.000- 4	(N,GAMMA)	6.4668- 4	1.1195- 3	1.2051- 1	3.8684- 4	1.6064- 3
12-MG- 24	1220	131	4.900+ 6	(N,P)	2.6023- 4	3.2212- 4	3.7045- 4	9.7495- 4	1.1686- 4
13-AL- 27	6314	162	1.800+ 6	(N,P)	6.4781- 4	8.7072- 4	1.0422- 3	2.3772- 3	4.0361- 4
13-AL- 27	6313	148	3.200+ 6	(N,ALPHA)	1.2752- 4	1.5376- 4	1.7605- 4	4.8320- 4	5.2859- 5
15-P - 31	1520	165	1.500+ 6	(N,P)	4.3118- 3	6.3249- 3	7.1466- 3	1.5969- 2	3.3082- 3
16-S - 32	6439	172	9.200+ 5	(N,P)	1.0564- 2	1.5235- 2	1.7459- 2	3.9128- 2	7.8640- 3
21-SC- 45	6426	620	1.000- 4	(N,GAMMA)	1.8844- 2	2.2776- 2	6.1330+ 0	9.1550- 3	4.3287- 2
22-TI- 46	6427	164	1.600+ 6	(N,P)	1.6906- 3	2.2447- 3	2.7295- 3	6.2080- 3	1.0551- 3
22-TI- 47	6428	74	1.060+ 7	(N,N'P)	2.3578- 6	1.2010- 6	5.9895- 6	1.2628- 5	0.0 + 0
22-TI- 47	6428	620	1.000- 4	(N,P)	3.4973- 3	5.1651- 3	5.6953- 3	1.2808- 2	2.6638- 3
22-TI- 48	6429	64	1.160+ 7	(N,N'P)	3.9137- 7	1.6729- 7	1.0986- 6	2.2089- 6	0.0 + 0
22-TI- 48	6429	148	3.200+ 6	(N,P)	4.9319- 5	5.9992- 5	7.0926- 5	1.8590- 4	2.1057- 5
25-MN- 55	6325	76	1.040+ 7	(N,2N)	5.1393- 5	3.9570- 5	9.1819- 5	2.2546- 4	2.0483- 8
26-FE- 0	8000	620	1.000- 4	DAMAGE (ASTM)	3.3876+ 2	3.9774+ 2	2.8194+ 2	6.3853+ 2	2.4957+ 2
26-FE- 0	8001	620	1.000- 4	DAMAGE (EUR)	3.3425+ 2	3.9293+ 2	2.7602+ 2	6.2447+ 2	2.5180+ 2
26-FE- 54	6430	620	1.000- 4	(N,P)	1.2146- 2	1.7456- 2	2.0075- 2	4.4850- 2	8.9323- 3
26-FE- 56	6431	151	2.900+ 6	(N,P)	1.7141- 4	2.2005- 4	2.5828- 4	6.3280- 4	8.6578- 5
26-FE- 58	6432	620	1.000- 4	(N,GAMMA)	3.4997- 3	6.2083- 3	2.7358- 1	2.1834- 3	1.1490- 2
27-CO- 59	6327	74	1.060+ 7	(N,2N)	4.7182- 5	3.5325- 5	8.7186- 5	2.1082- 4	0.0 + 0
27-CO- 59	6327	620	1.000- 4	(N,GAMMA)	1.2501- 2	4.2104- 2	9.8651+ 0	7.9656- 3	3.6950- 2
27-CO- 59	6327	125	5.500+ 6	(N,ALPHA)	2.6063- 5	3.2027- 5	3.7269- 5	9.8072- 5	1.1592- 5
28-NI- 58	6433	56	1.240+ 7	(N,2N)	8.2365- 7	3.7525- 7	2.2344- 6	4.6356- 6	0.0 + 0
28-NI- 58	6433	620	1.000- 4	(N,P)	1.5972- 2	2.3139- 2	2.6200- 2	5.8688- 2	1.1864- 2
28-NI- 60	6434	155	2.500+ 6	(N,P)	4.1972- 4	5.4362- 4	6.4051- 4	1.5497- 3	2.2917- 4
29-CU- 63	2920	68	1.120+ 7	(N,2N)	2.2262- 5	1.4248- 5	4.8214- 5	1.0901- 4	0.0 + 0
29-CU- 63	6435	620	1.000- 4	(N,GAMMA)	2.2065- 2	3.6533- 2	1.0733+ 0	1.3414- 2	7.2055- 2
29-CU- 63	6435	163	1.700+ 6	(N,ALPHA)	9.2342- 5	1.1694- 4	1.3656- 4	3.4394- 4	4.6628- 5
29-CU- 65	6436	80	1.000+ 7	(N,2N)	7.6062- 5	6.1474- 5	1.2742- 4	3.2236- 4	4.4088- 7
30-ZN- 64	3020	171	9.600+ 5	(N,P)	5.3973- 3	7.7604- 3	8.9363- 3	1.9986- 2	3.9661- 3
40-ZR- 90	4020	59	1.210+ 7	(N,2N)	2.2625- 5	1.1848- 5	5.7136- 5	1.2230- 4	0.0 + 0
41-NB- 93	4120	207	1.350+ 5	(N,N') FIRST LEVEL	3.6112- 2	5.2271- 2	4.5111- 2	1.0509- 1	2.7608- 2
45-RH-103	4520	215	1.000+ 5	(N,N') FIRST LEVEL	2.2319- 1	2.9227- 1	2.1313- 1	5.0898- 1	1.5964- 1
49-IN-115	6437	193	3.200+ 5	(N,N') FIRST LEVEL	3.4537- 2	5.2569- 2	4.9148- 2	1.1324- 1	2.7619- 2
49-IN-115	6437	620	1.000- 4	(N,GAMMA)	2.1865- 1	2.6289- 1	1.1973+ 2	1.5482- 1	4.0871- 1
53-I -127	6438	88	9.200+ 6	(N,2N)	2.7342- 4	2.5299- 4	3.8598- 4	1.0787- 3	2.4795- 5
79-AU-197	6379	620	1.000- 4	(N,GAMMA)	2.1268- 1	3.3537- 1	6.3461+ 1	1.2029- 1	6.2426- 1
90-TH-232	6390	410	5.000+ 0	FISSION	1.2645- 2	1.9606- 2	2.0097- 2	4.5529- 2	1.0256- 2
90-TH-232	6390	620	1.000- 4	(N,GAMMA)	1.8189- 1	2.3548- 1	4.1004+ 0	1.2342- 1	3.6763- 1
92-U -235	6395	620	1.000- 4	FISSION	1.3657+ 0	1.5049+ 0	1.3039+ 2	1.2603+ 0	1.8911+ 0
92-U -238	6398	620	1.000- 4	FISSION	5.2575- 2	8.2130- 2	8.2518- 2	1.8711- 1	4.3207- 2
92-U -238	6398	620	1.000- 4	(N,GAMMA)	1.5058- 1	2.0937- 1	1.0372+ 1	9.6809- 2	3.3498- 1
93-NP-237	6337	620	1.000- 4	FISSION	4.6708- 1	6.1326- 1	4.2887- 1	1.0208+ 0	3.3176- 1
94-PU-239	6399	620	1.000- 4	FISSION	1.6199+ 0	1.7522+ 0	2.0778+ 2	1.7224+ 0	1.7988+ 0
95-AM-241	1009	620	1.000- 4	FISSION	3.5943- 1	5.1993- 1	1.5281+ 0	9.8590- 1	2.0374- 1

VIII. Comparison to Experimental Measurements

This section presents comparisons between ^{235}Cf and ^{235}U experimentally measured spectra averages and the calculated spectra averages presented in the preceding section. These results are presented in a format similar to that of the preceding section, with one line for each reaction in the IRDF-82 library and where available the comparisons to experimental values. The numbers in parentheses following the experimental values refer to the following references:

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[5] WINKLER, G., et al., Nuc. Sci. and Eng. 78, (1981) 415.

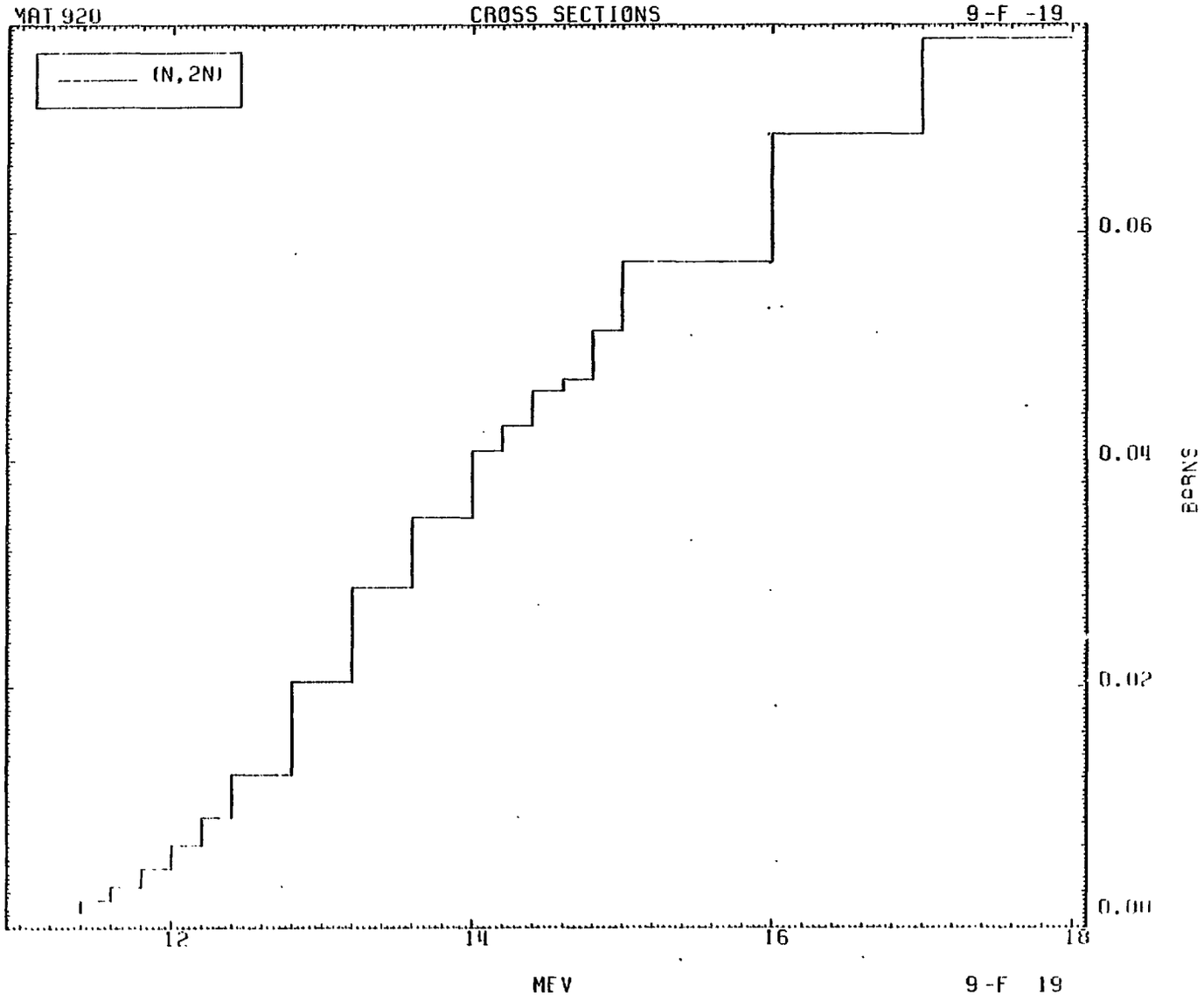
[6] DEZSOE, Z., and CSIKAI, J., Proc. VIIth Symposium on Interactions of Fast Neutrons, Gaussig, (1977).

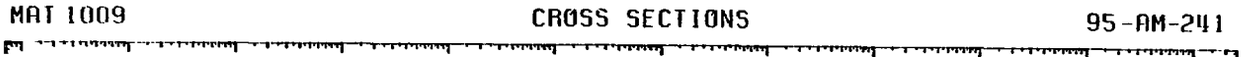
COMPARISON OF EXPERIMENTIALLY MEASURED AND CALCULATED CF-252 AND U-235 FISSION SPECTRA AVERAGES

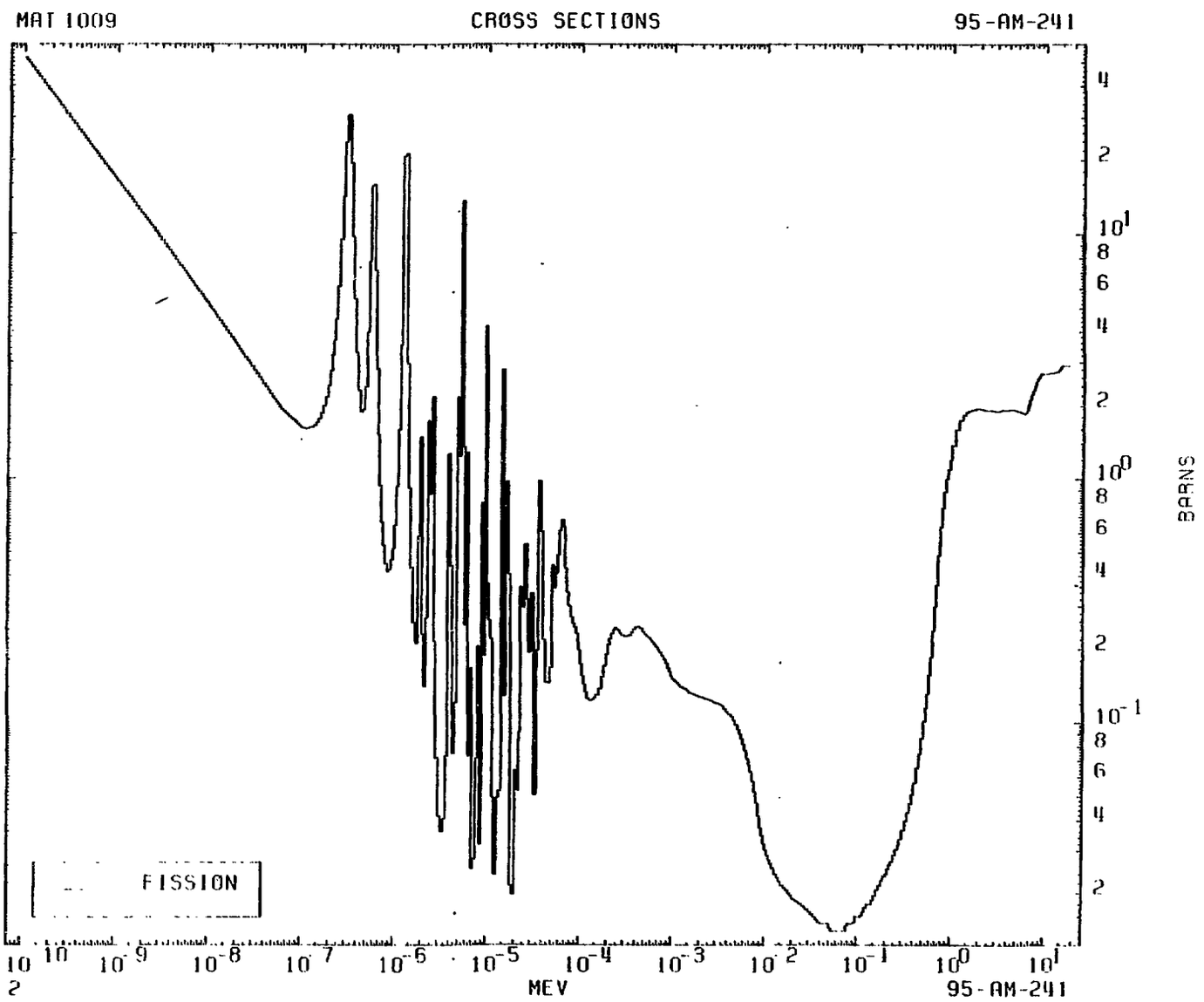
ISOTOPE	MAT	GROUPS	THRESHOLD (EV)	REACTION	EXPERIMENTAL VALUES CF-252 FISS (MILLIBARNS)		EXPERIMENTAL VALUES U-235 FISS (MILLIBARNS)		EXPERIMENTAL ERROR (PER-CENT)	COMPARISON TO CALCULATIONS (EVAL-EXP)/EVAL CF-252 FISS (NBS) (PER-CENT)	COMPARISON TO CALCULATIONS (EVAL-EXP)/EVAL U-235 FISS (NBS) (PER-CENT)	COMPARISON TO CALCULATIONS (EVAL-EXP)/EVAL U-235 FISS (ENDF/B-V) (PER-CENT)
3-LI- 6	6424	620	1.000- 4	HELIUM PRODUCTION								
5-B - 10	6425	620	1.000- 4	HELIUM PRODUCTION								
9-F - 19	920	70	1.100+ 7	(N,2N)	0.0108	(1)			15	+30		
11-NA- 23	1120	51	1.290+ 7	(N,2N)								
11-NA- 23	6311	620	1.000- 4	(N,GAMMA)	0.335	(1)			4	-24		
12-MG- 24	1220	131	4.900+ 6	(N,P)	1.918	(2)			4.9	+11		
13-AL- 27	6313	162	1.800+ 6	(N,P)	4.862	(2)			3.55	+5		
13-AL- 27	6313	148	3.200+ 6	(N,ALPHA)	1.014	(2)			2	+4		
15-P - 31	1520	165	1.500+ 6	(N,P)			33.5	(3)	4		-22	-17
16-S - 32	6439	172	9.200+ 5	(N,P)	71.78	(2)			4.5	+6		
21-SC- 45	6426	620	1.000- 4	(N,GAMMA)								
22-TI- 46	6427	164	1.600+ 6	(N,P)	14.11	(2)			2.2	-5		
22-TI- 47	6428	74	1.060+ 7	(N,N'P)								
22-TI- 47	6428	620	1.000- 4	(N,P)	19.26	(2)			2.12	+20		
22-TI- 48	6429	64	1.160+ 7	(N,N'P)								
22-TI- 48	6429	148	3.200+ 6	(N,P)	0.38	(1)			5	+7		
25-MN- 55	6325	76	1.040+ 7	(N,2N)			0.202	(4)	5		-0.2	-0.4
26-FE- 0	8000	620	1.000- 4	DAMAGE (ASTM)								
26-FE- 0	8001	620	1.000- 4	DAMAGE (EUR)								
26-FE- 54	6430	620	1.000- 4	(N,P)	86.55	(2)			2.12	+2		
26-FE- 56	6431	151	2.900+ 6	(N,P)	1.459	(2)			2.36	-3		
26-FE- 58	6432	620	1.000- 4	(N,GAMMA)								
27-CO- 59	6327	74	1.060+ 7	(N,2N)			0.227	(4)			-24	-26
27-CO- 59	6327	620	1.000- 4	(N,GAMMA)	6.97	(1)			5	-14		
27-CO- 59	6327	135	5.500+ 6	(N,ALPHA)	0.2186	(1)			7.41	+1		
28-NI- 58	6433	56	1.240+ 7	(N,2N)			0.0036	(4)	7		-26	-32
28-NI- 58	6433	620	1.000- 4	(N,P)	115.4	(2)			1.47	-1.4		
28-NI- 60	6434	155	2.500+ 6	(N,P)								
29-CU- 63	2920	68	1.120+ 7	(N,2N)	0.3	(1)			9	-56		
29-CU- 63	6435	620	1.000- 4	(N,GAMMA)								
29-CU- 63	6435	143	1.700+ 6	(N,ALPHA)	0.709	(5)			2	+4		
29-CU- 65	6436	80	1.000+ 7	(N,2N)								
30-ZN- 64	3020	171	9.600+ 5	(N,P)	40.14	(2)			2.46	-2		
40-ZR- 90	4020	59	1.210+ 7	(N,2N)	0.267	(1)			9	-35		
41-NB- 93	4120	209	1.350+ 5	(N,N') FIRST LEVEL								
45-RH-103	4520	215	1.000+ 5	(N,N') FIRST LEVEL								
49-IN-115	6437	193	3.200+ 5	(N,N') FIRST LEVEL	197.9	(2)			2.19	-9		
49-IN-115	6437	620	1.000- 4	(N,GAMMA)	125.7	(2)			2.96	-4		
53-I -127	6438	98	9.200+ 6	(N,2N)			1.04	(4)			+12	+14
79-AU-197	6379	620	1.000- 4	(N,GAMMA)	76.83	(2)			2.27	-1		
90-TH-232	6390	410	5.000+ 0	FISSION	84.7	(6)			.17	-8		
90-TH-232	6390	620	1.000- 4	(N,GAMMA)								
92-U -235	6395	620	1.000- 4	FISSION	1204	(2)			1.61	+3		
92-U -238	6398	620	1.000- 4	FISSION	319.1	(2)			2.08	-2		
92-U -238	6398	620	1.000- 4	(N,GAMMA)								
93-NP-237	6337	620	1.000- 4	FISSION	1339	(2)			2.14	+1		
94-PU-239	6399	620	1.000- 4	FISSION	1798	(2)			1.83	+0.3		
95-AM-241	1009	620	1.000- 4	FISSION								

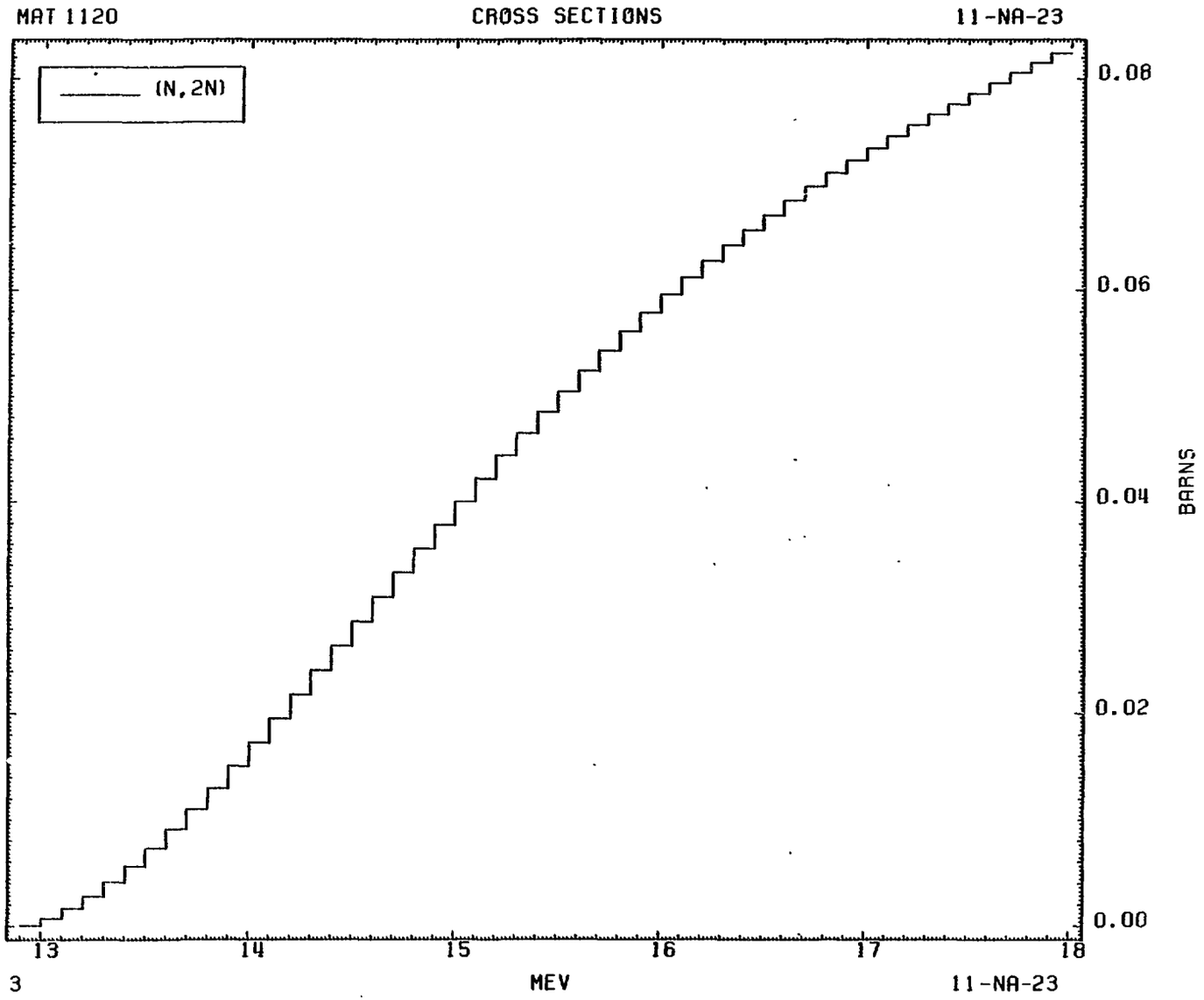
IX. Plots of Cross Sections

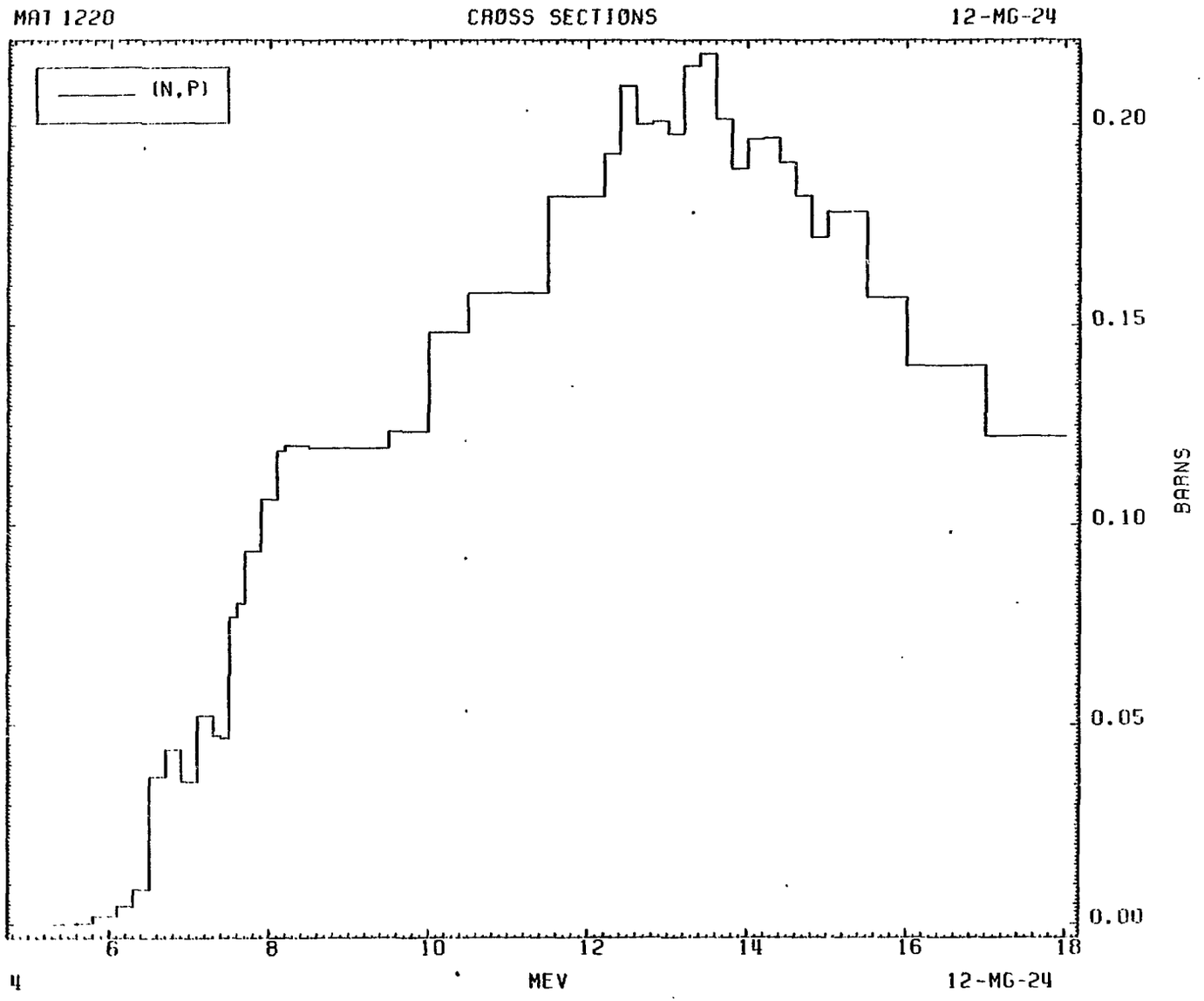
In this section plots are presented in the order in which they appear in the ENDF/B format; that is they are in MAT number, as opposed to ZA, order. The MAT number assigned to each material may be determined by consulting section V in which there is a ZA ordered list of materials with their associated MAT numbers.

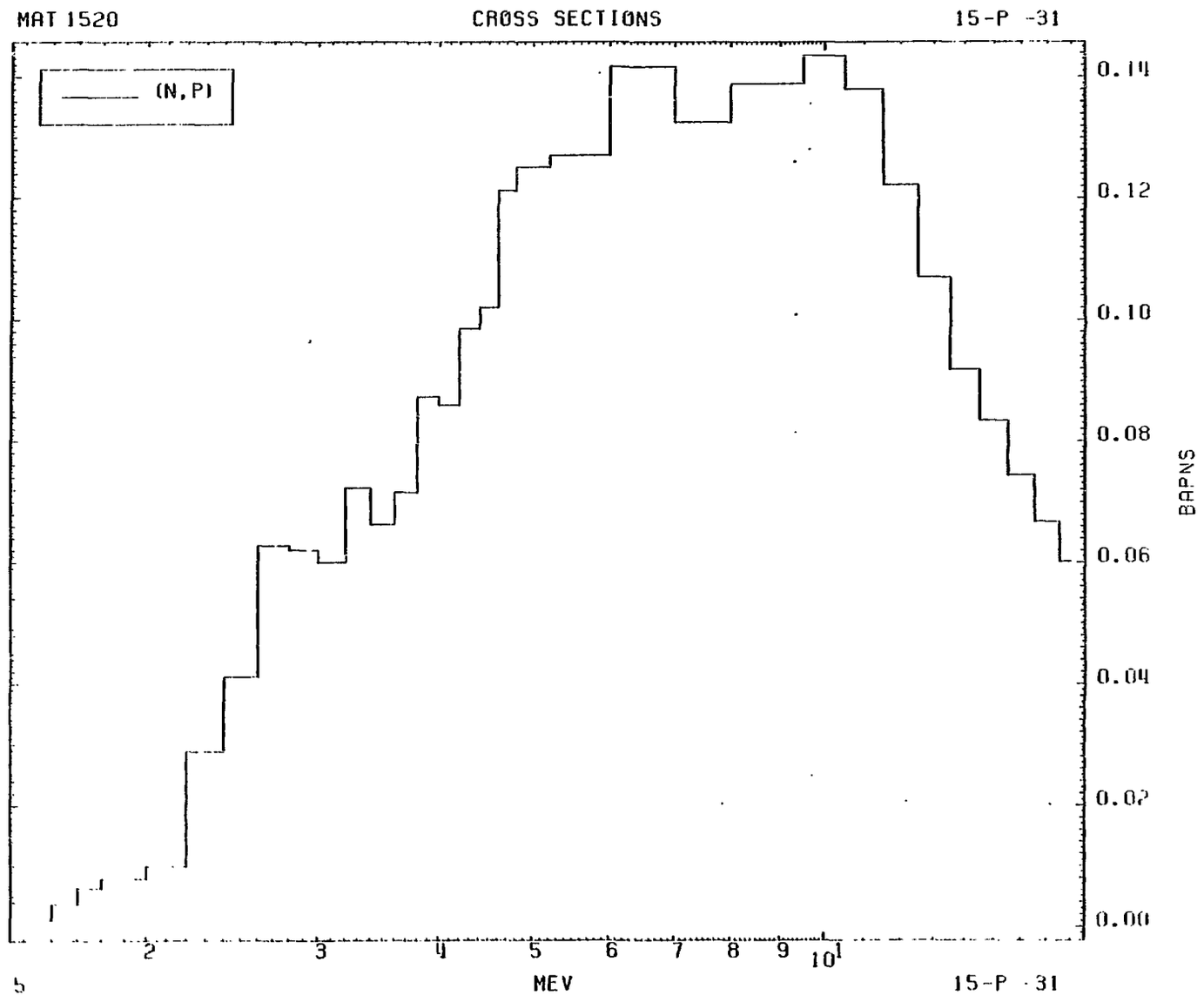

MAT 920
CROSS SECTIONS
9-F -19
(N,2N)
0.06
0.04
0.02
0.00
BARNS
12
14
16
18
MEV
9-F 19

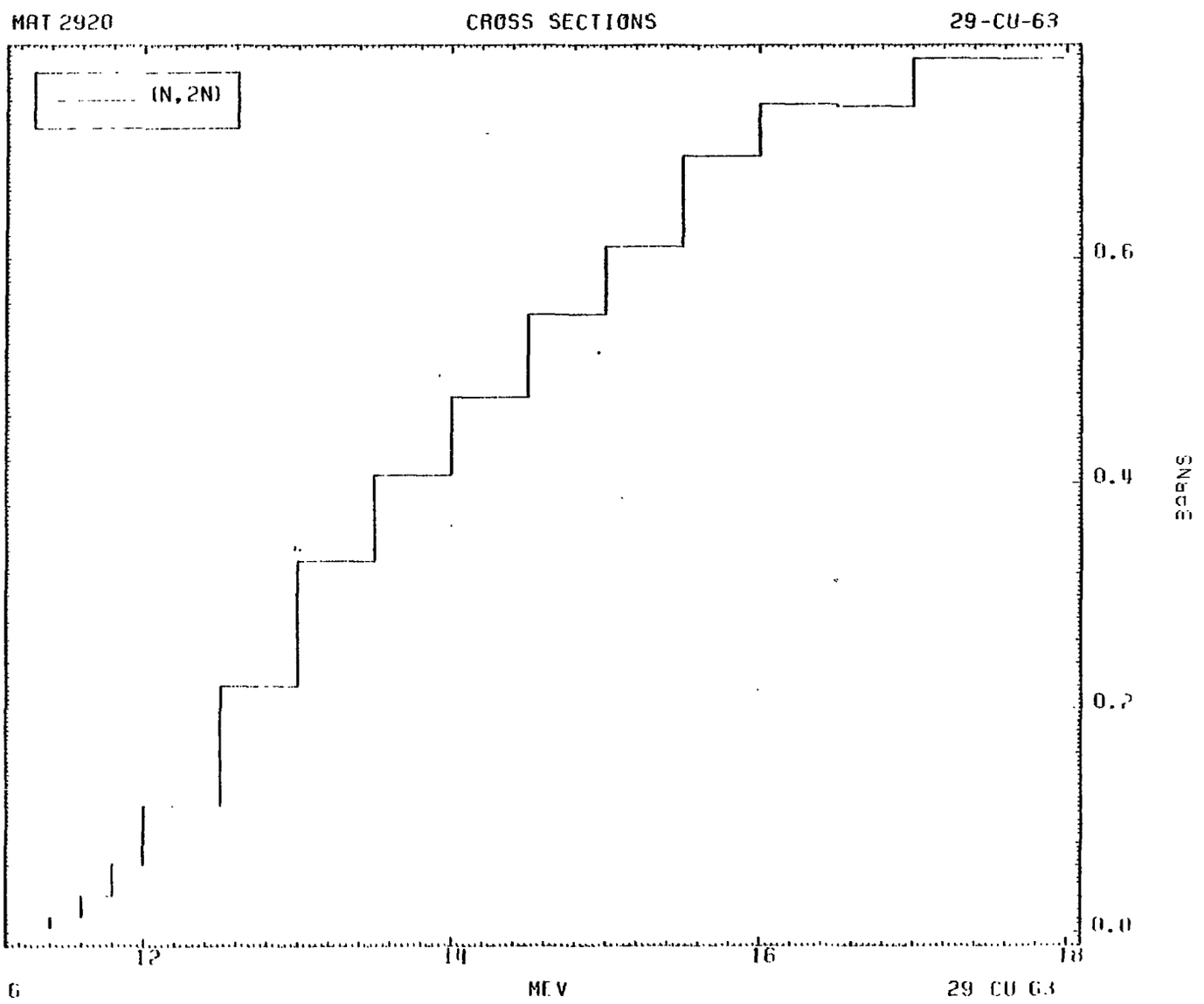

MAT 1009
CROSS SECTIONS
95-AM-241

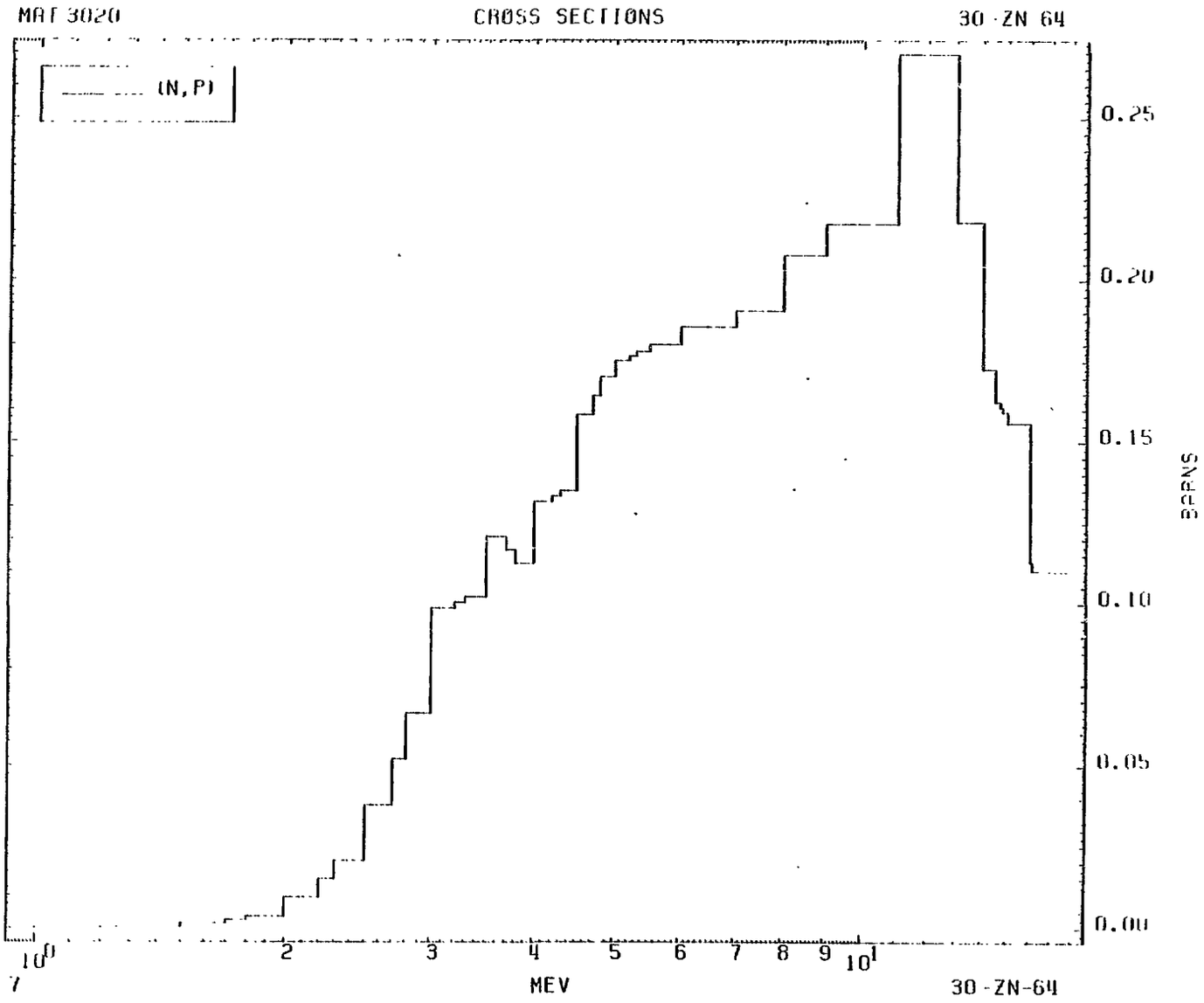

MAT 1009
CROSS SECTIONS
95-AM-241
4
2
10^1
8
6
4
2
10^0
8
6
4
2
10^-1
8
6
4
2
BARNS
FISSION
10^2
10^-10
10^-9
10^-8
10^-7
10^-6
10^-5
10^-4
10^-3
10^-2
10^-1
10^0
10^1
MEV
95-AM-241

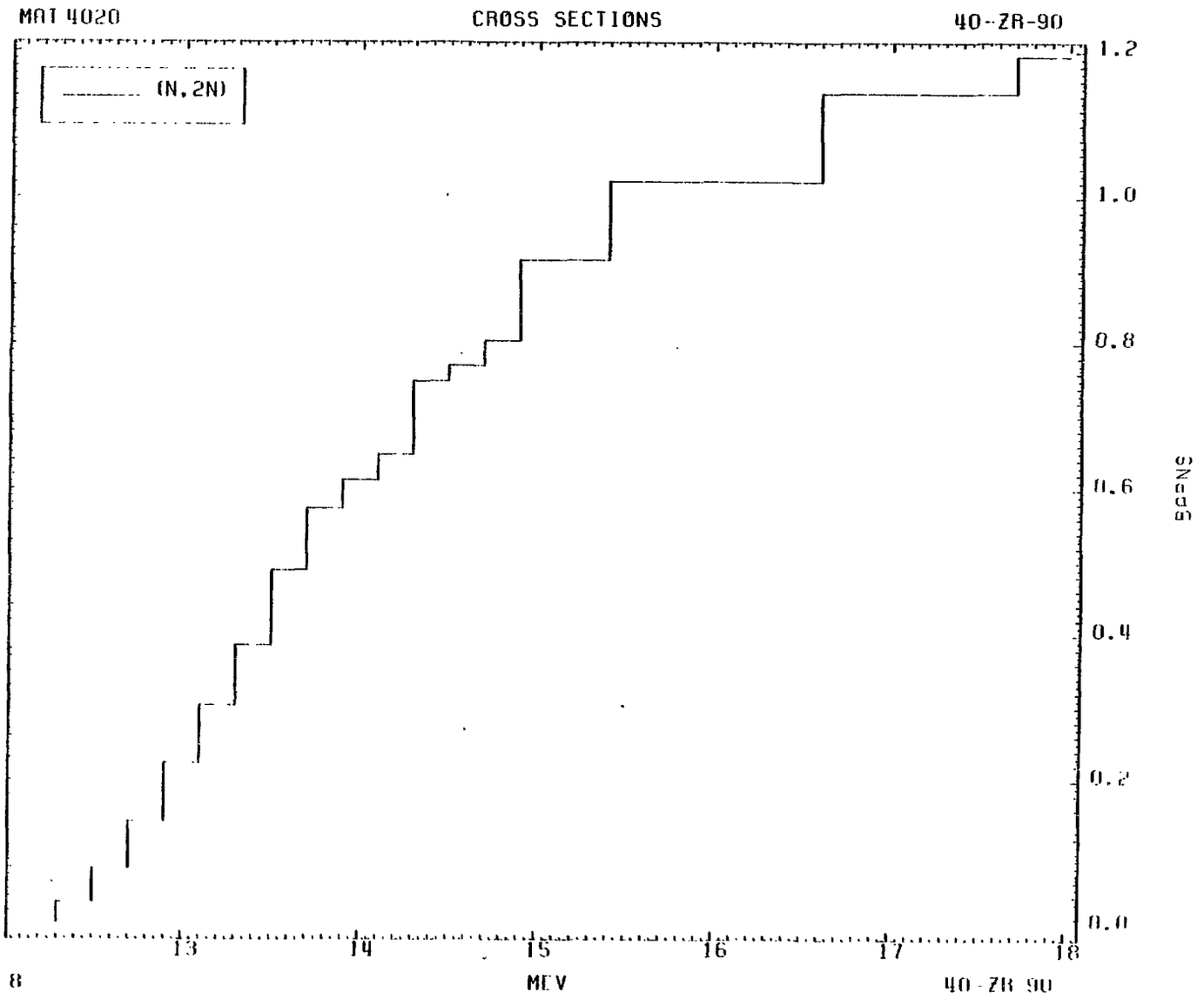

MAT 1120
CROSS SECTIONS
11-NA-23
(N,2N)
0.08
0.06
0.04
0.02
0.00
BARNS
13
14
15
16
17
18
3
MEV
11-NA-23

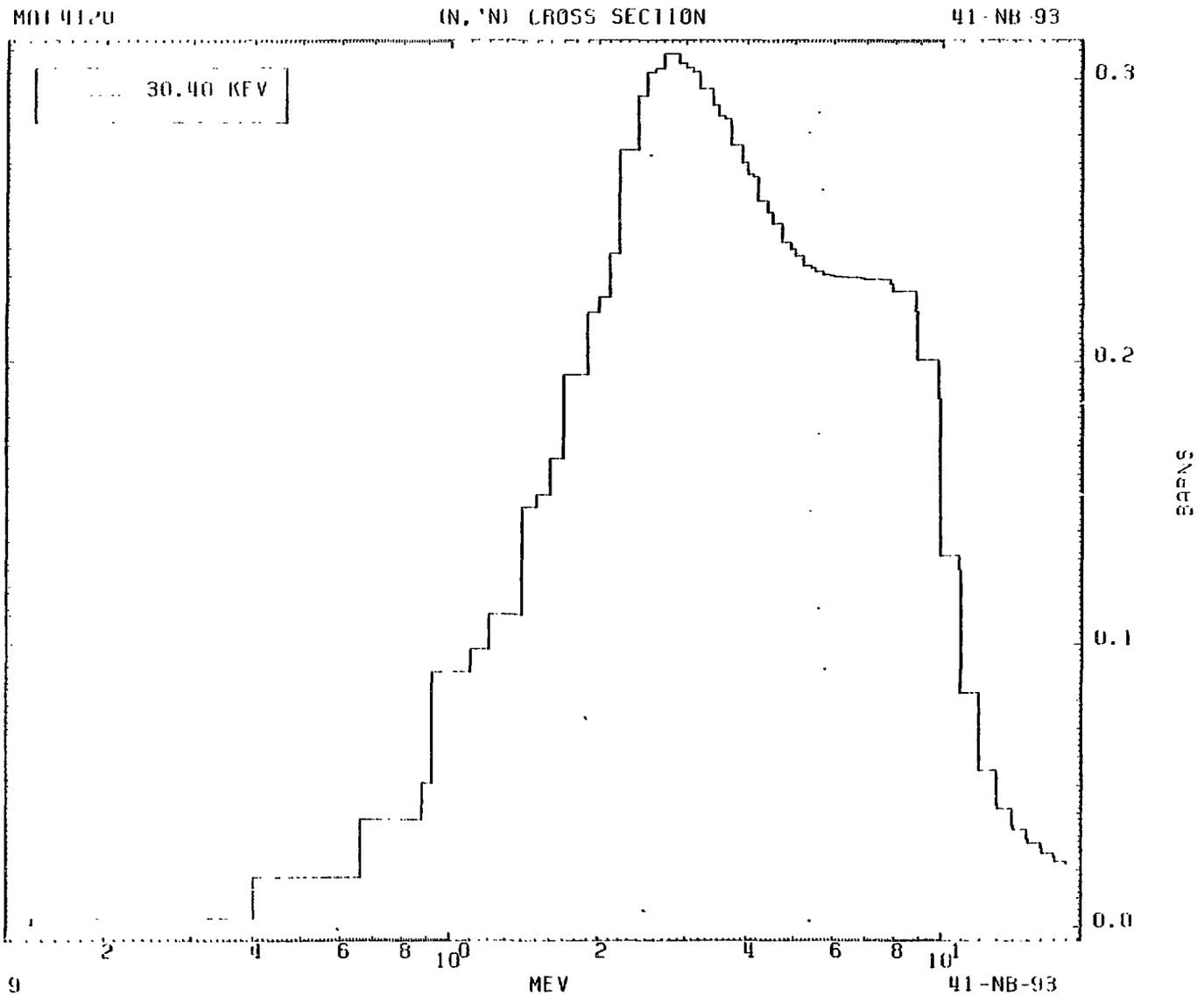

MAT 1220
CROSS SECTIONS
12-MG-24
(N,P)
0.20
0.15
0.10
0.05
0.00
BARNS
6
8
10
12
14
16
18
MEV
12-MG-24

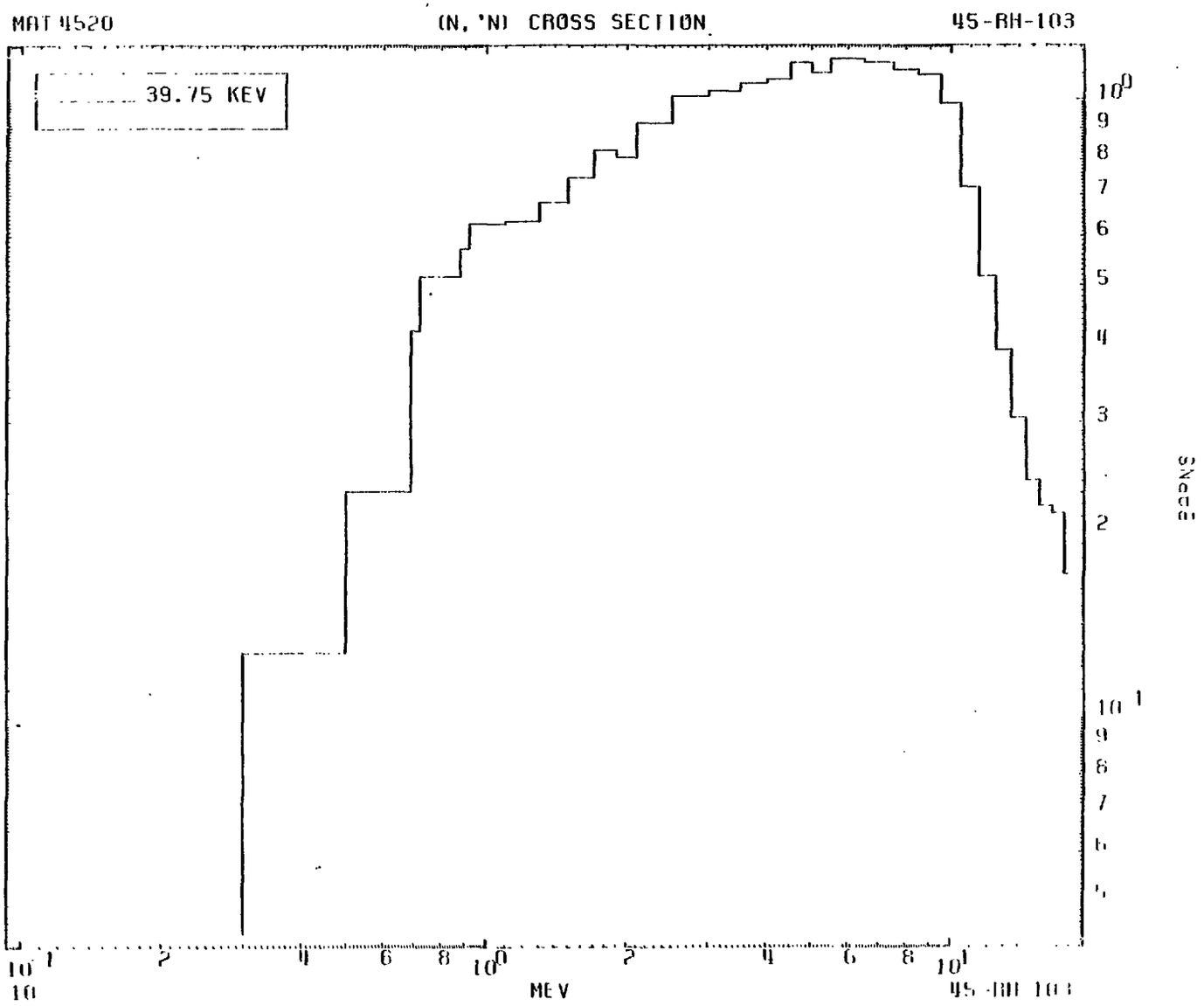

MAT 1520
CROSS SECTIONS
15-P -31
(N,P)
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
BARNS
2
3
4
5
6
7
8
9
10
MEV
15-P -31

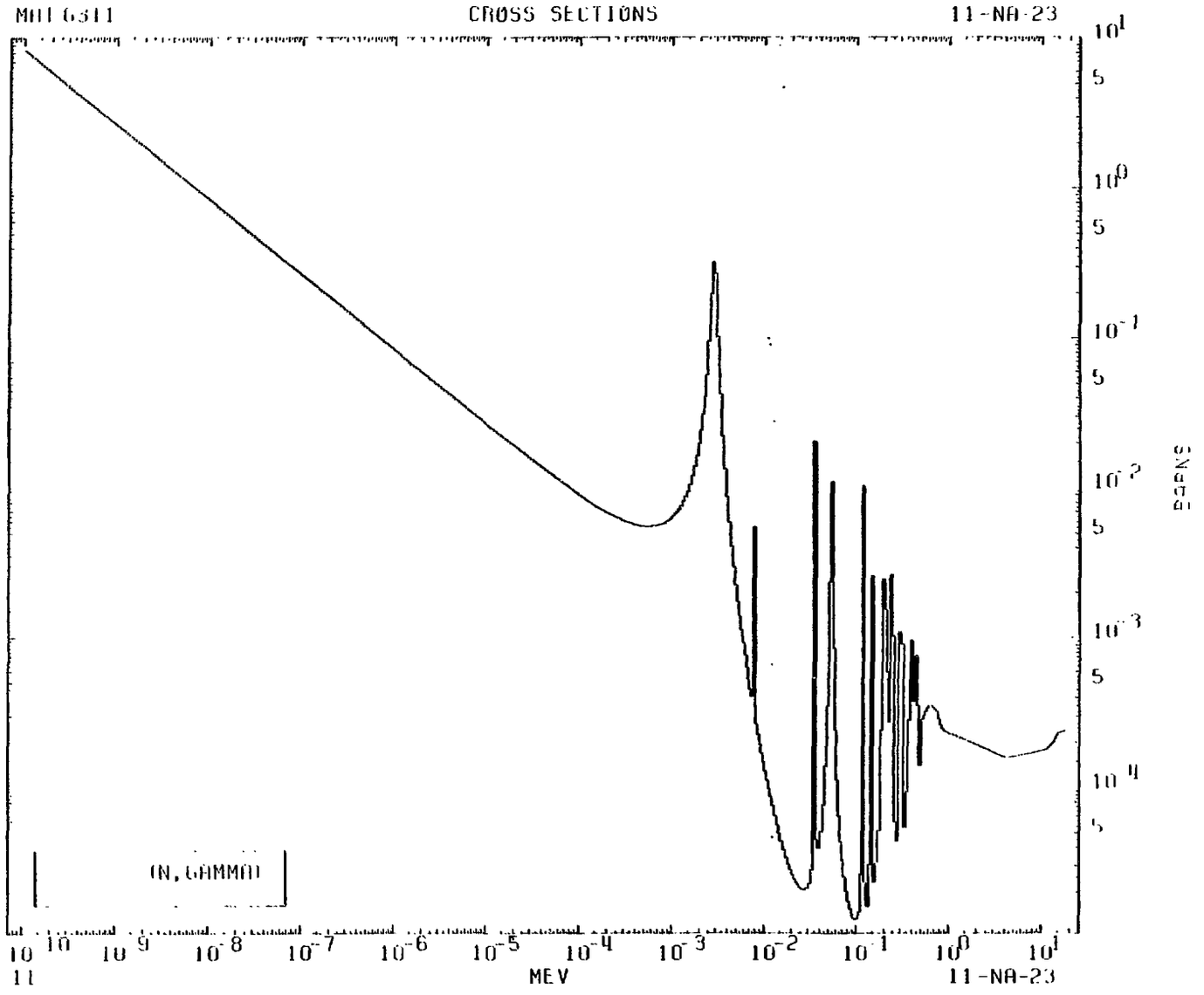

MAT 2920
CROSS SECTIONS
29-CU-63
(N,2N)
0.6
0.4
0.2
0.0
BARNS
12
14
16
18
6
MEV
29 CU 63

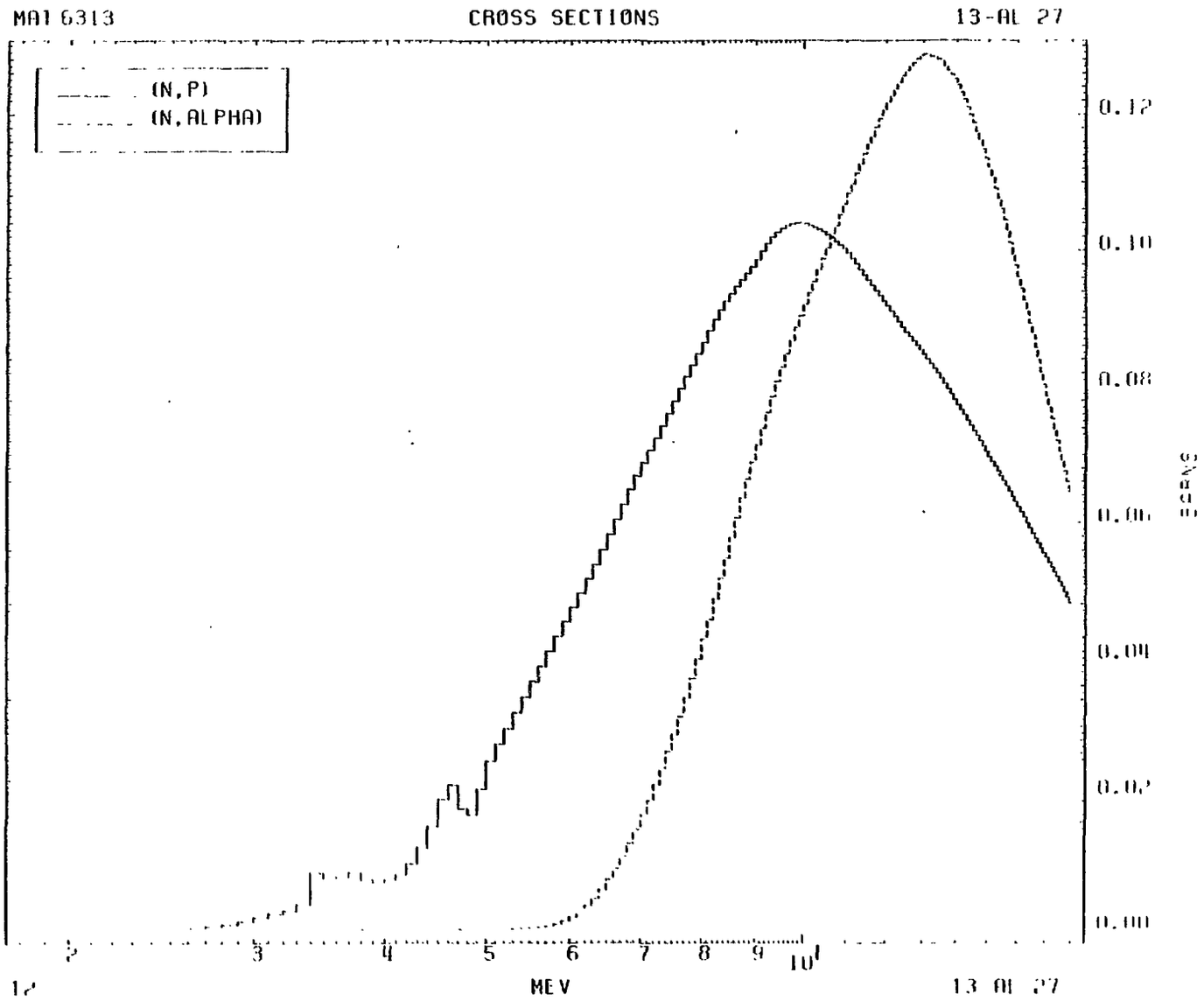

MAT 3020
CROSS SECTIONS
30-ZN 64
(N,P)
0.25
0.20
0.15
0.10
0.05
0.00
BARNS
10^0
2
3
4
5
6
7
8
9
10^1
MEV
30-ZN-64

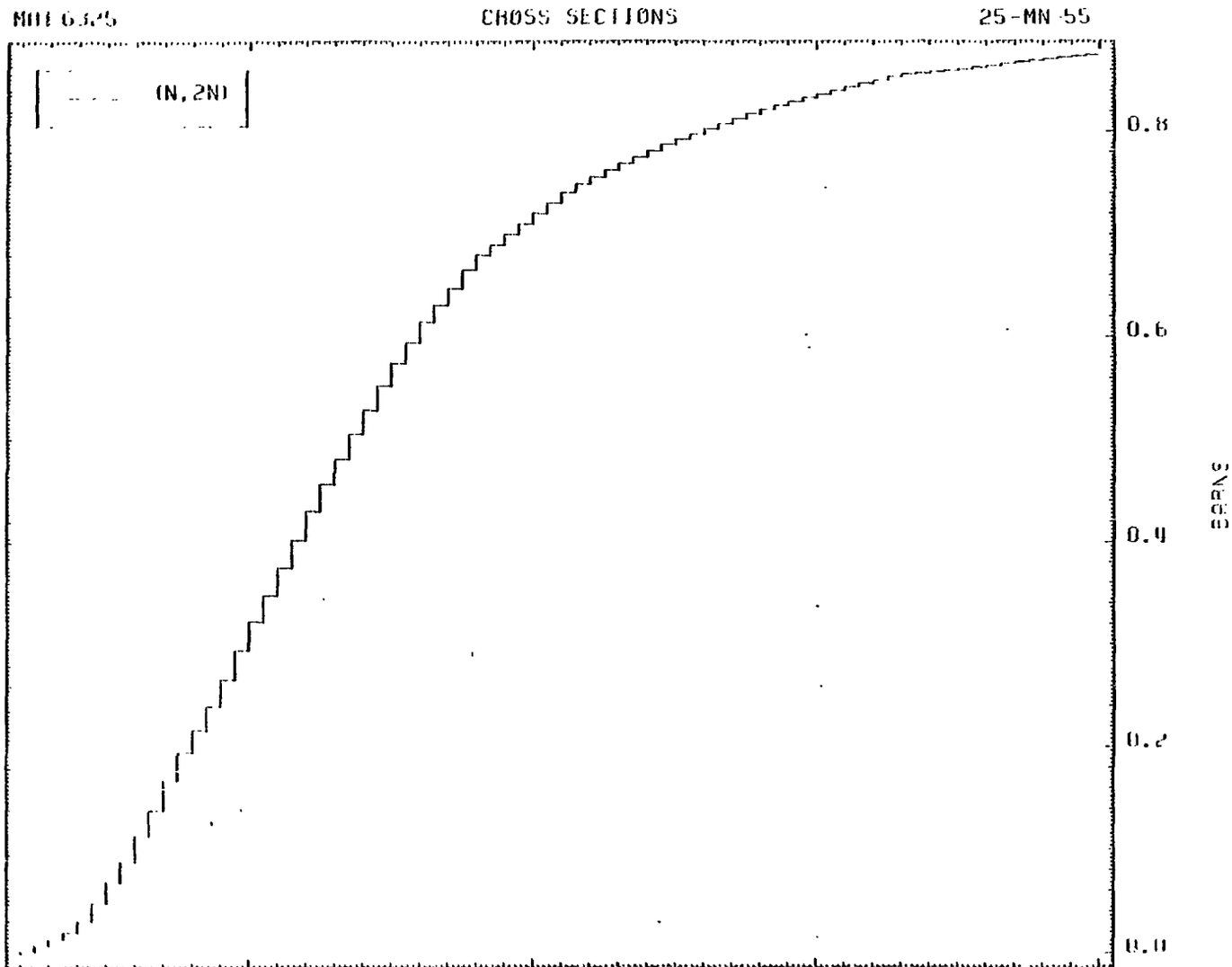

MAT 4020
CROSS SECTIONS
40-ZR-90
(N,2N)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
BARNS
13
14
15
16
17
18
8
MEV
40-ZR 90

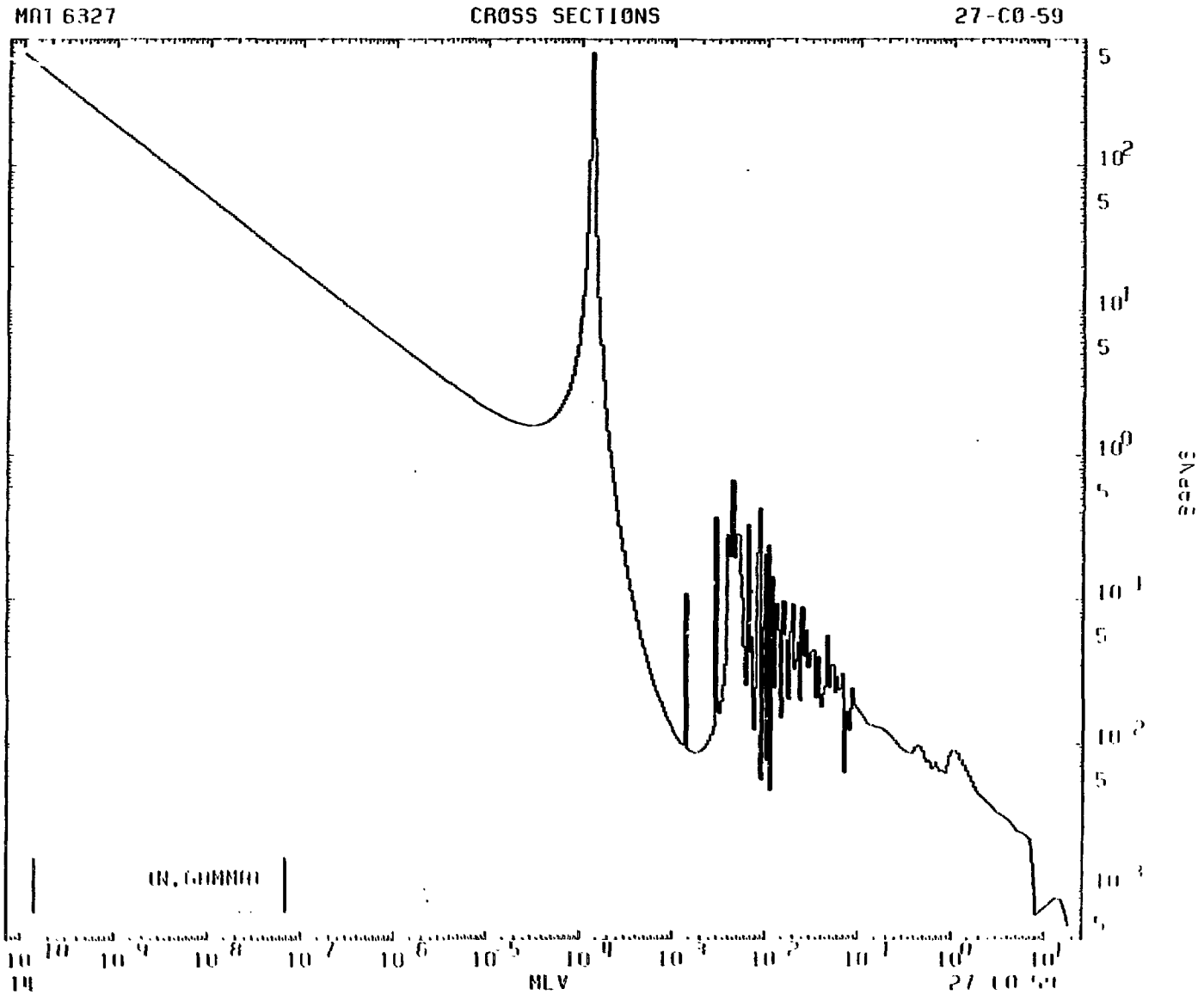

MAT 4120
(N,'N) CROSS SECTION
41-NB-93
30.40 KEV
0.3
0.2
0.1
0.0
BARNS
2
4
6
8
10^0
2
4
6
8
10^1
9
MEV
41-NB-93

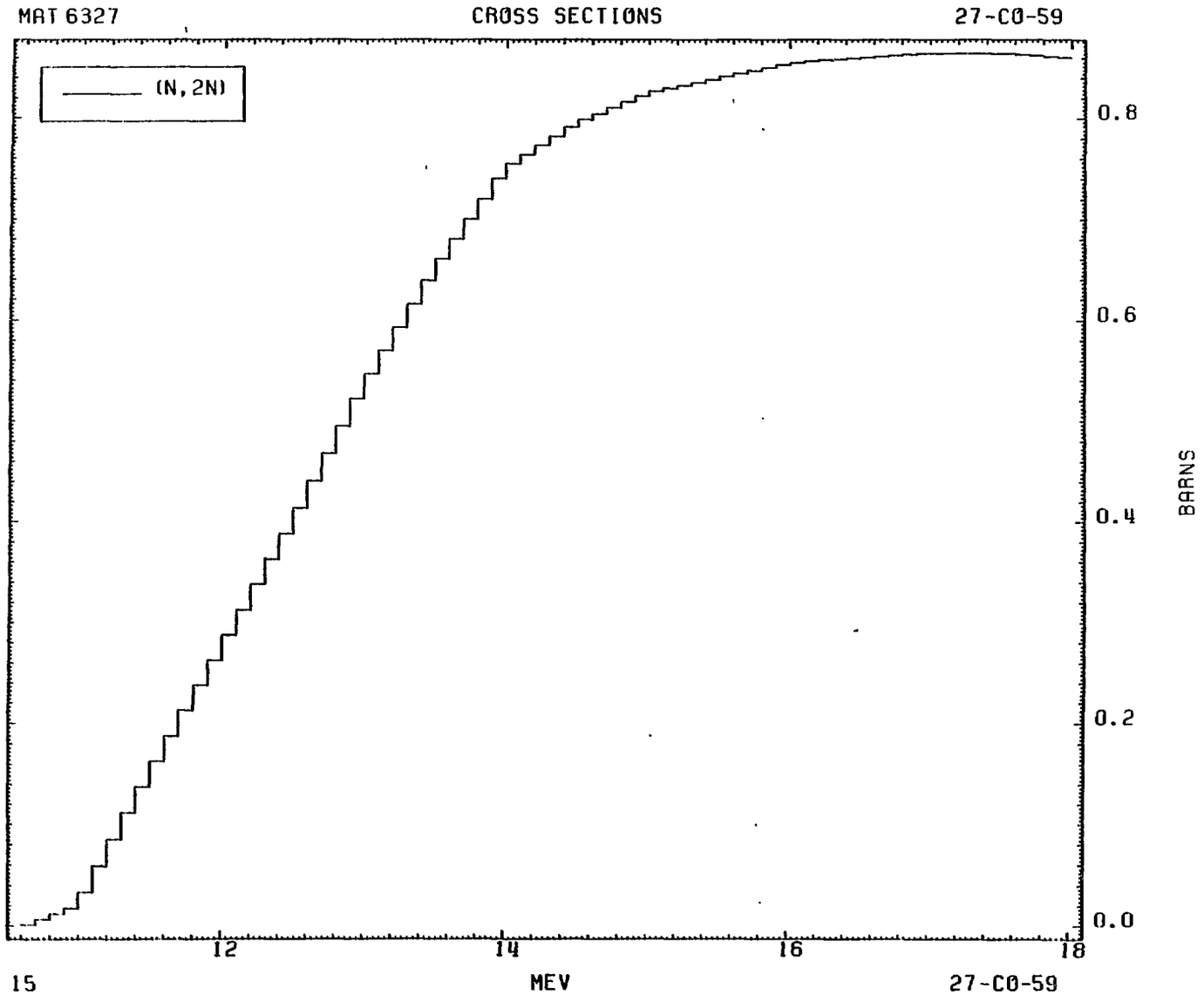

MAT 4520
(N, 'N) CROSS SECTION
45-RH-103
39.75 KEV
BARNS
MEV
45-RH-103


MAT 6311
CROSS SECTIONS
11-NA-23
BARNS
(N,GAMMA)
MEV
11-NA-23

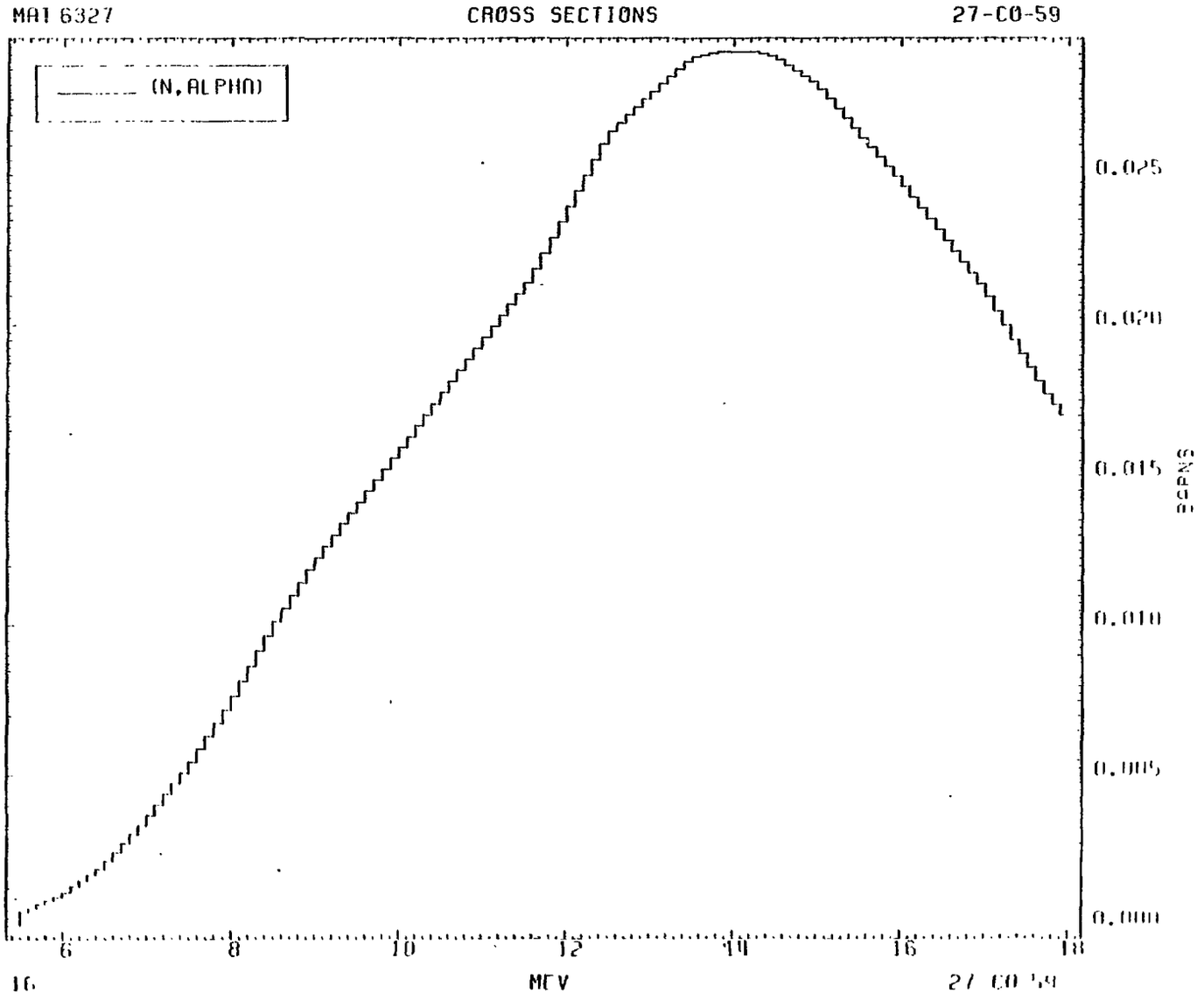

MAT 6313
CROSS SECTIONS
13-AL 27
(N,P)
(N,ALPHA)
0.12
0.10
0.08
0.06
0.04
0.02
0.00
BARNS
3
4
5
6
7
8
9
10
MEV
13 AL 27

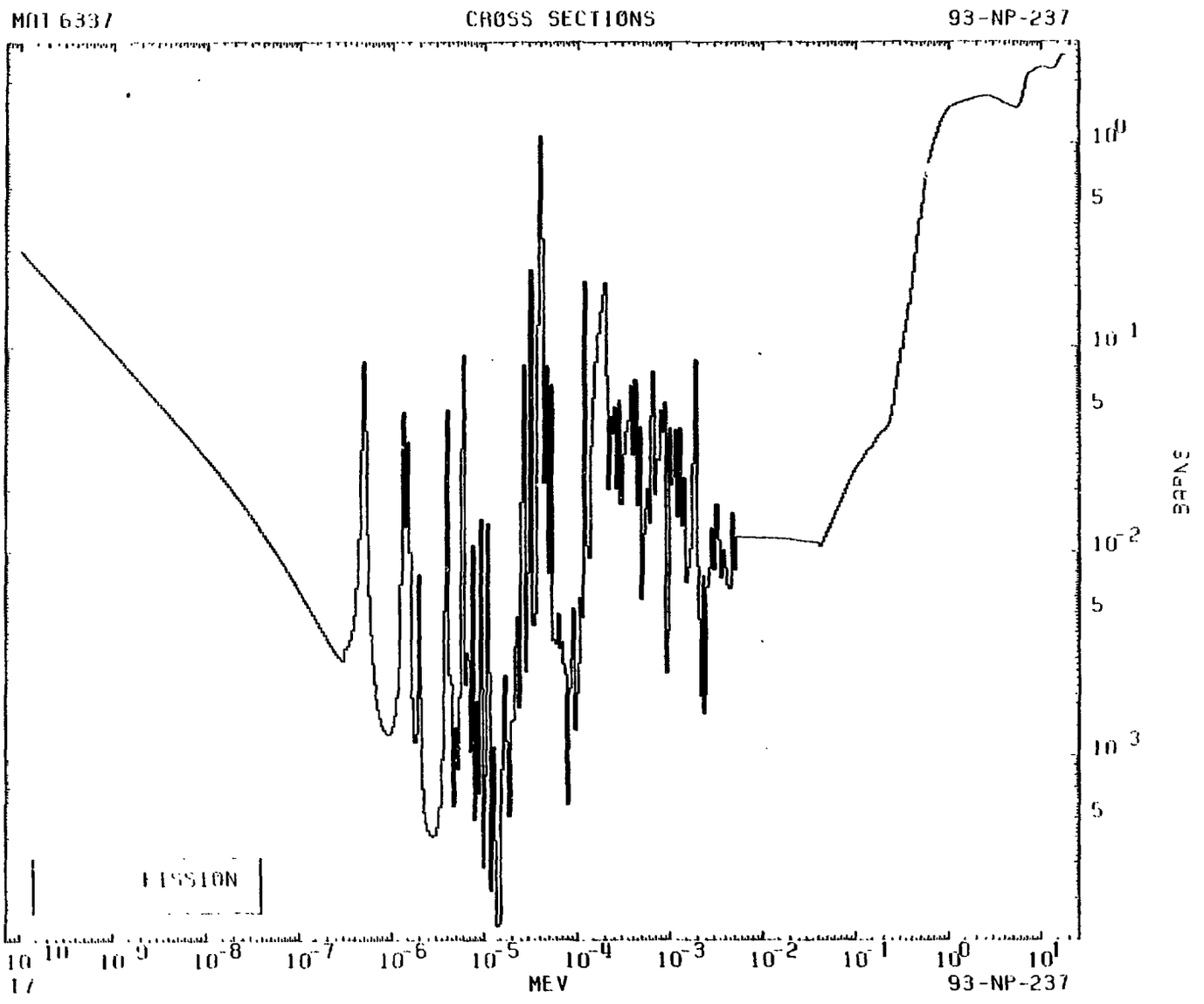

MAT 6325
CROSS SECTIONS
25-MN-55
(N,2N)
0.8
0.6
0.4
0.2
0.0
BARNS
12
14
16
18
13
MEV
25-MN-55

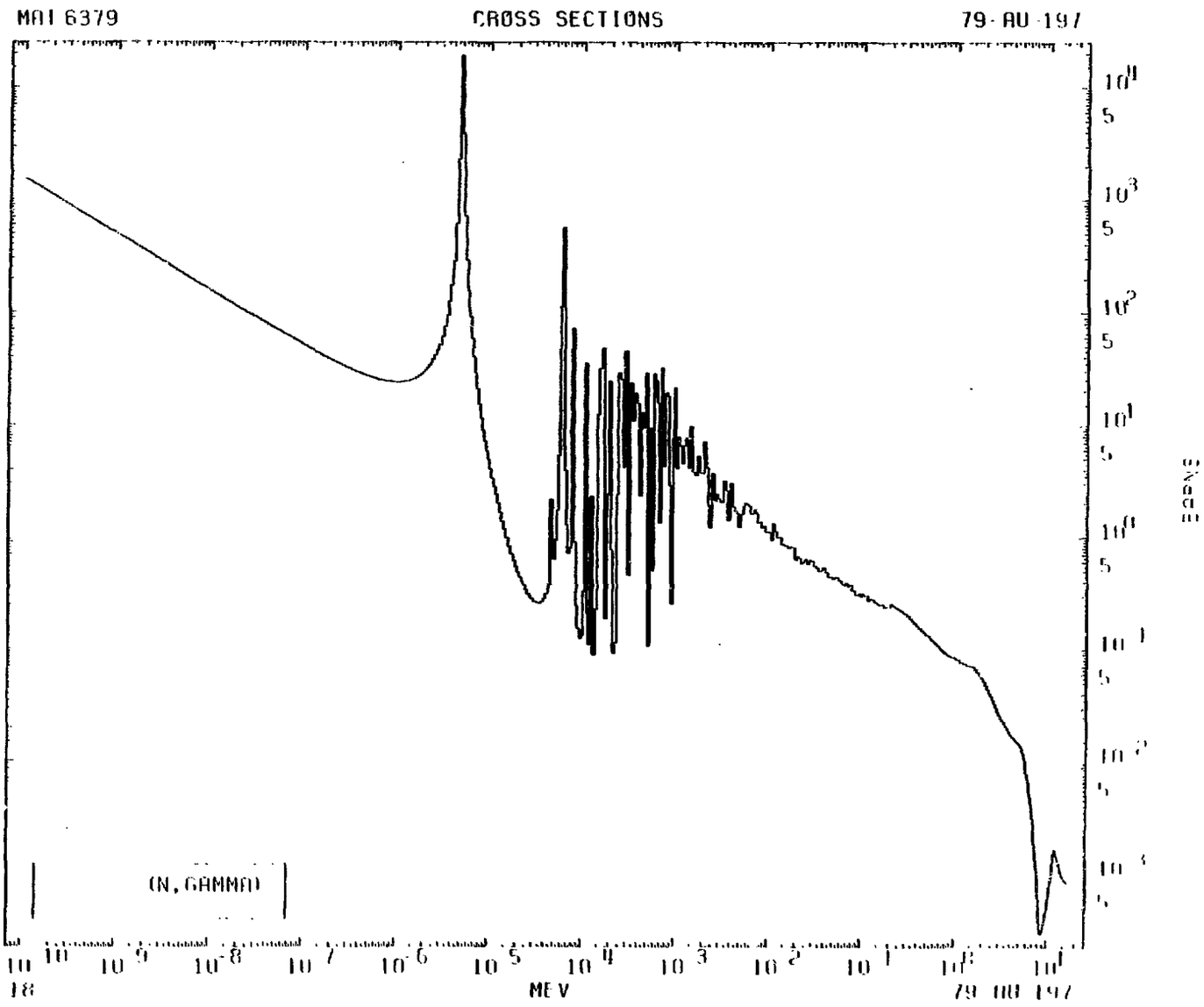

MAT 6327
CROSS SECTIONS
27-CO-59
BARNS
5
10²
5
10¹
5
10⁰
5
10⁻¹
5
10⁻²
5
10⁻³
5
(N,GAMMA)
10⁻¹⁰ 10⁻⁹ 10⁻⁸ 10⁻⁷ 10⁻⁶ 10⁻⁵ 10⁻⁴ 10⁻³ 10⁻² 10⁻¹ 10⁰ 10¹
MEV

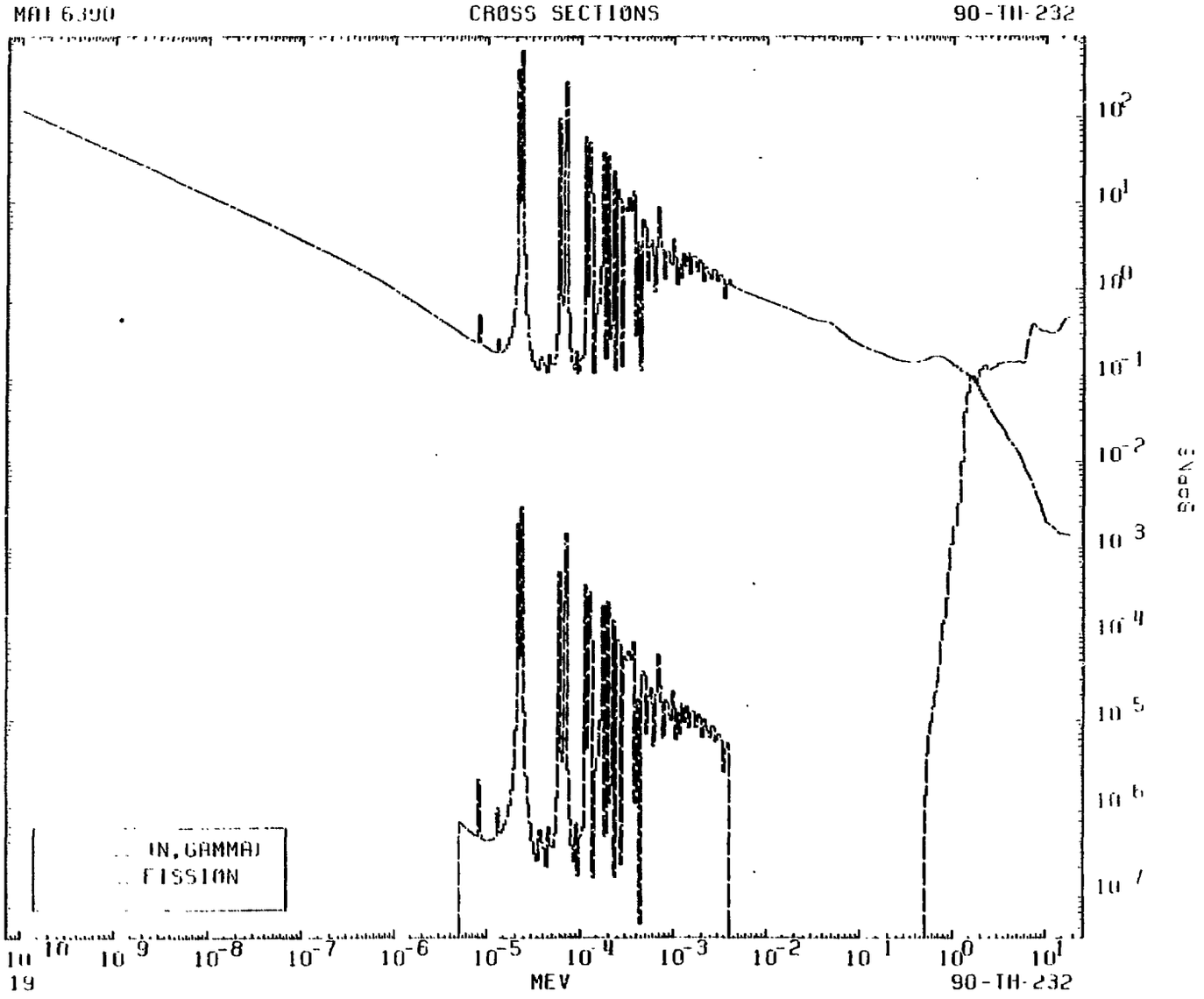


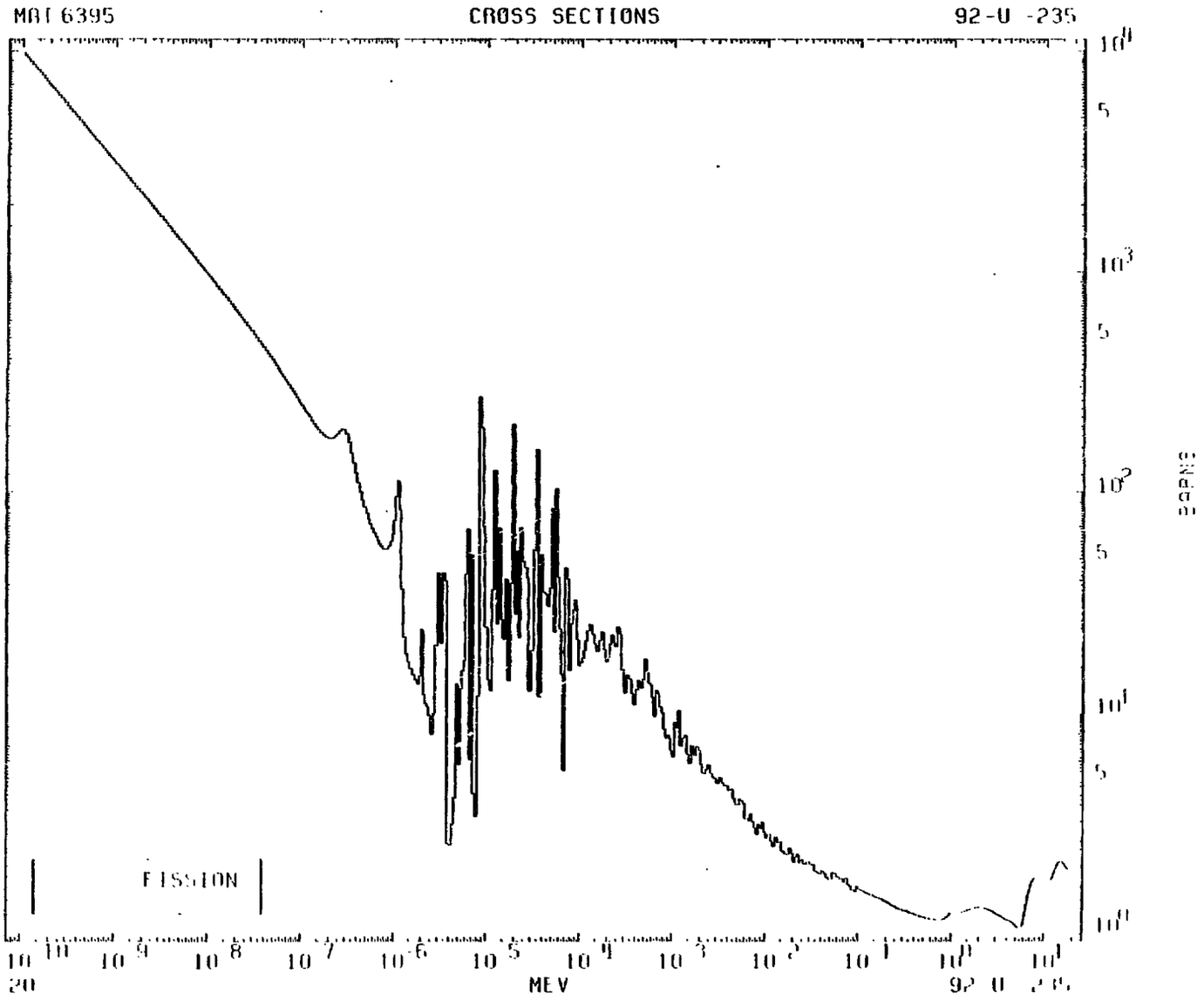
MAT 6327
CROSS SECTIONS
27-C0-59


MAT 6327
CROSS SECTIONS
27-CO-59
(N,ALPHA)
0.025
0.020
0.015
0.010
0.005
0.000
BARNS
6
8
10
12
14
16
18
MEV
27 CO 59


MAT 6337
CROSS SECTIONS
93-NP-237
FISSION
BARNS
MEV
93-NP-237


MAT 6379
CROSS SECTIONS
79-AU-197
(N,GAMMA)
MEV
79 08 197
BARNS


MAT 6390
CROSS SECTIONS
90-TH-232
(N,GAMMA)
FISSION
BARNS
MEV
90-TH-232
19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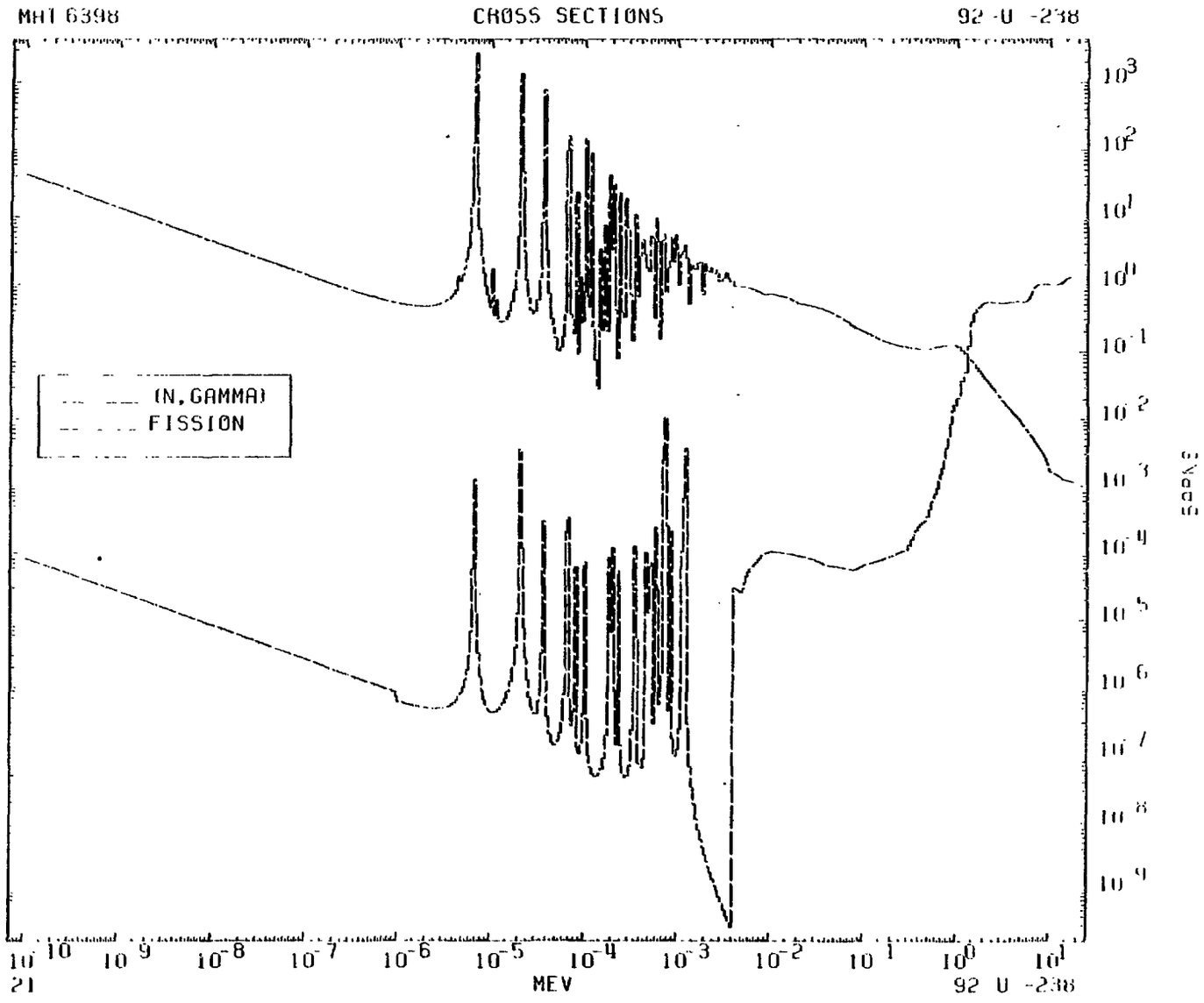
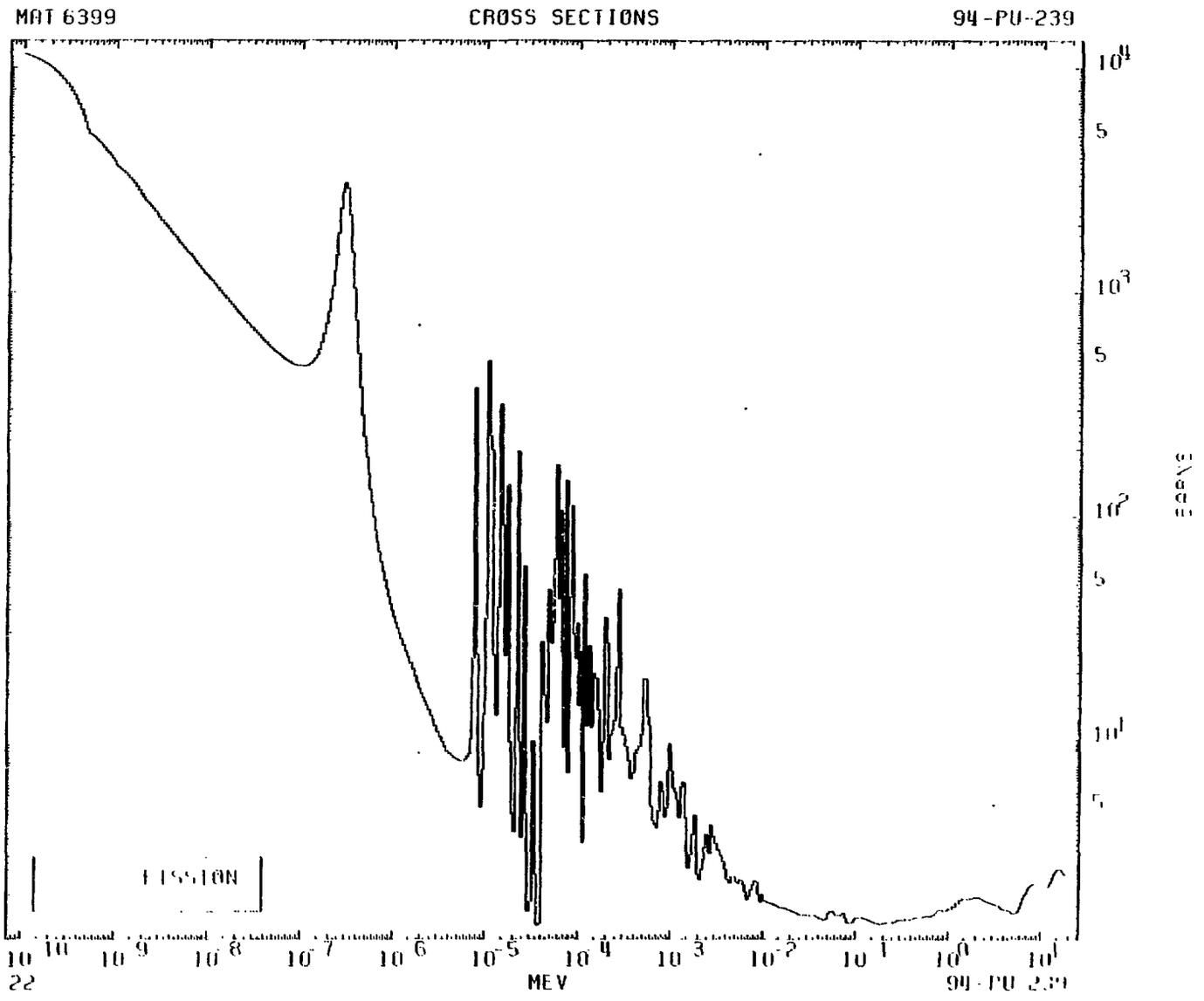
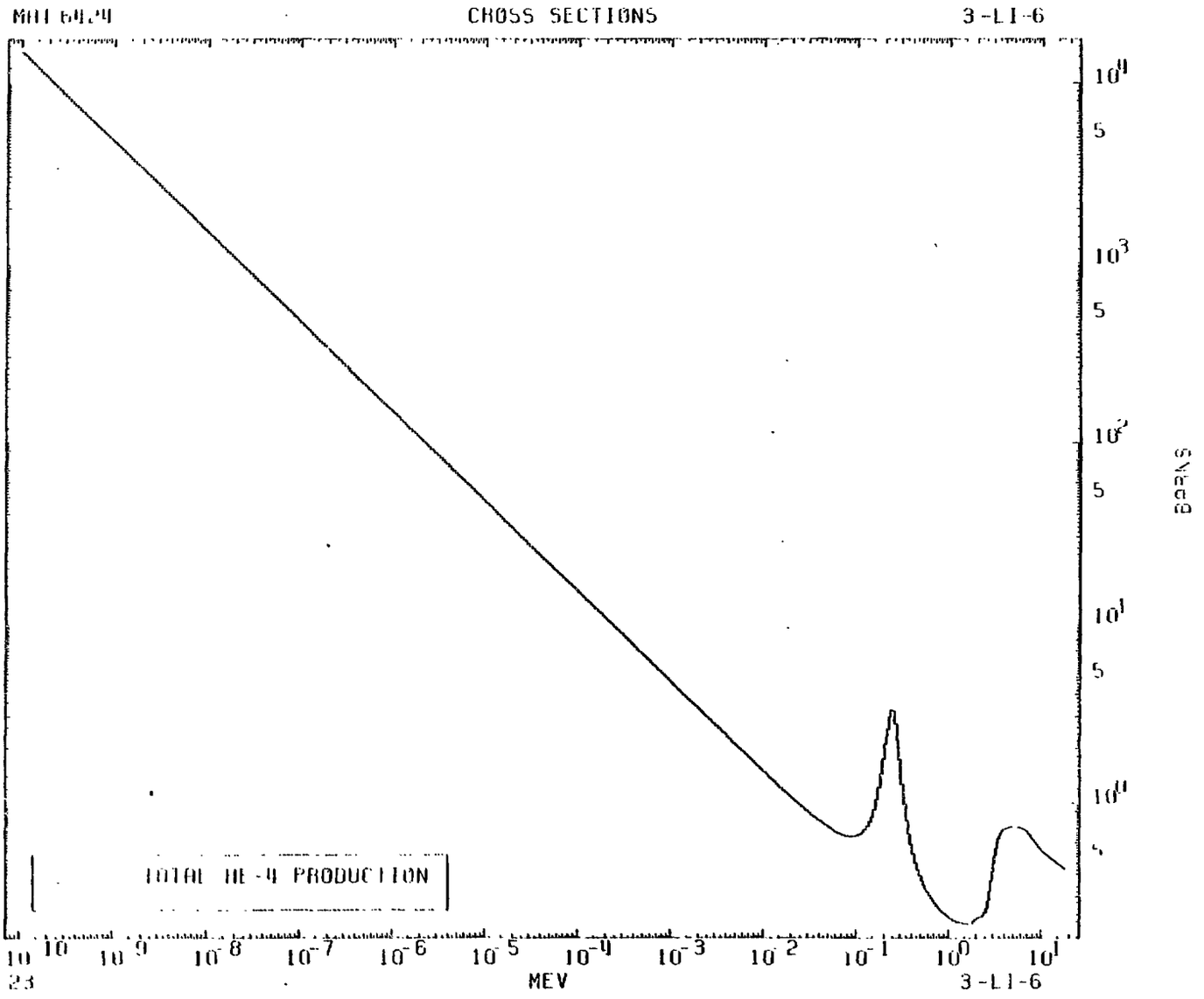
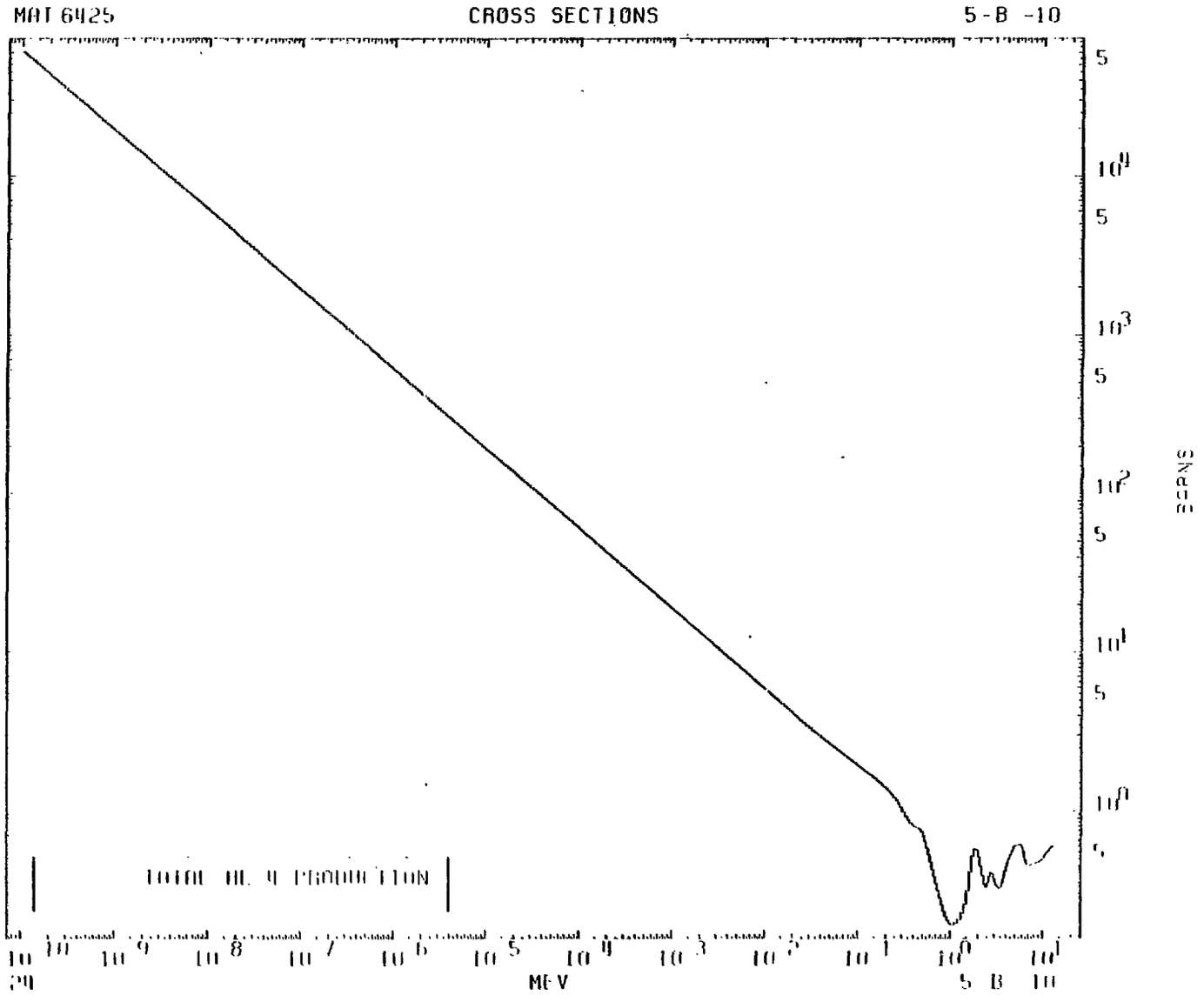
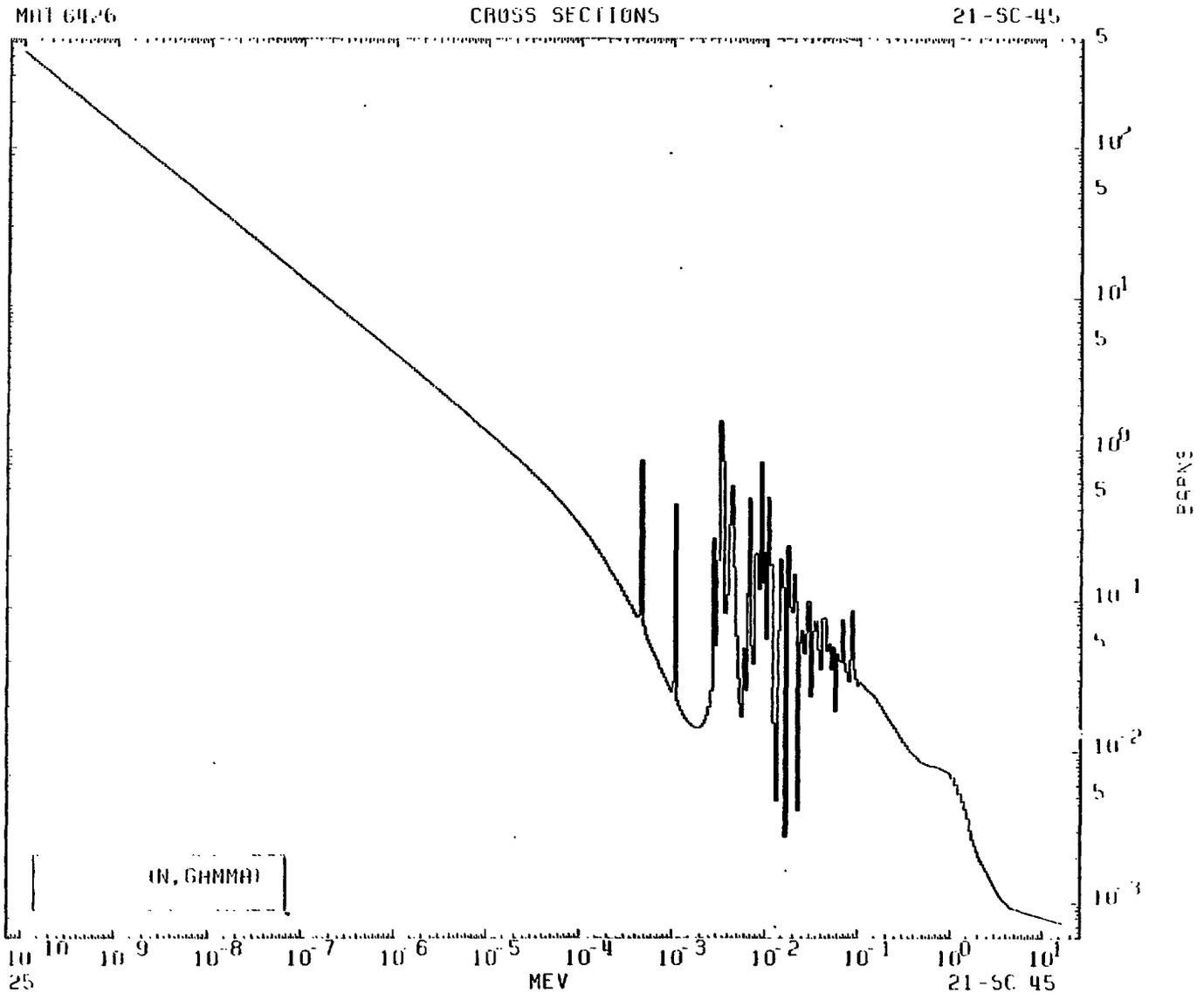
CROSS SECTIONS
92-U -235
FISSION
BARNS
MEV
92 U 235

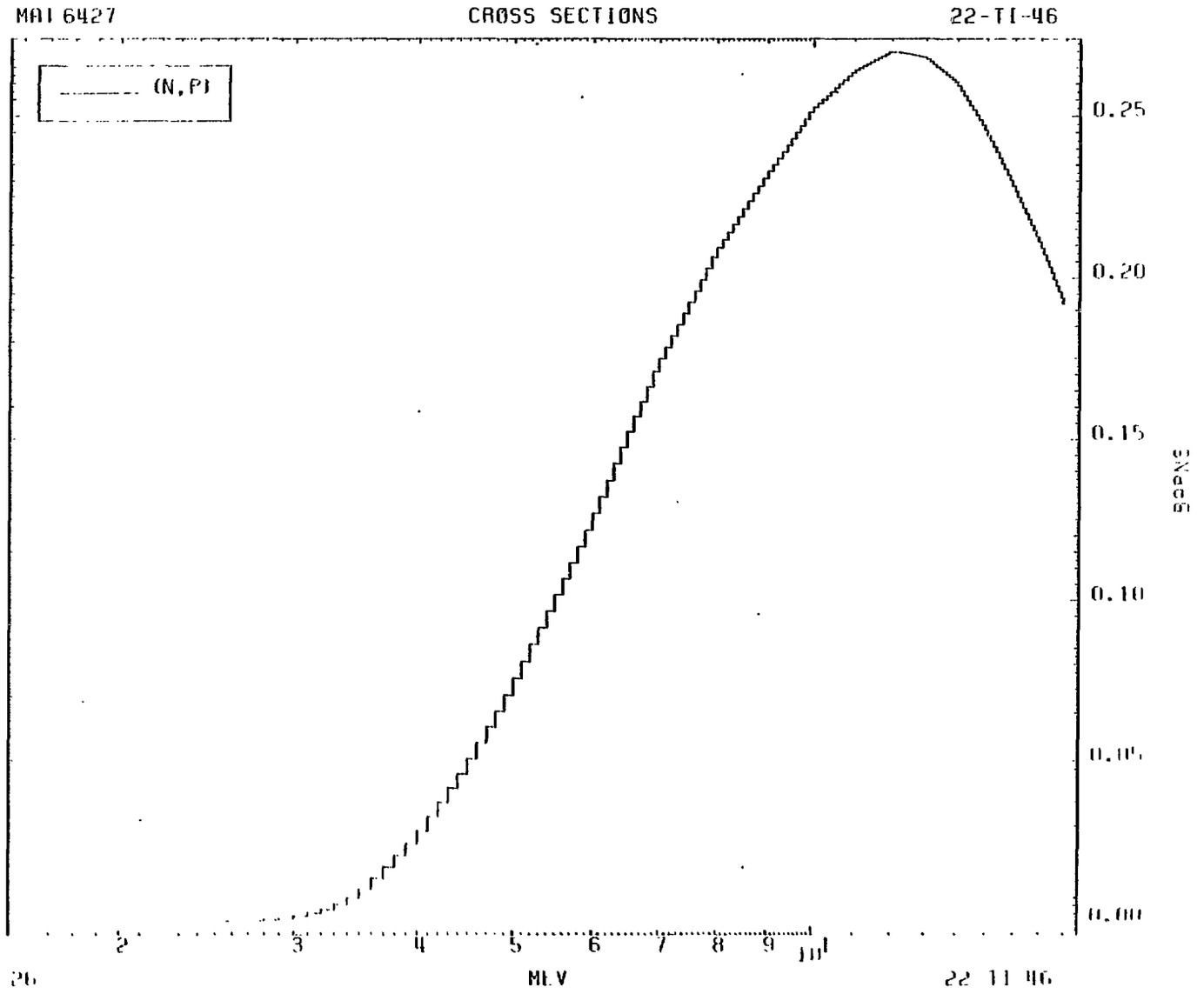

MAT 6398
CROSS SECTIONS
92-U -238
(N,GAMMA)
FISSION
BARNS
MEV
21
92 U -238

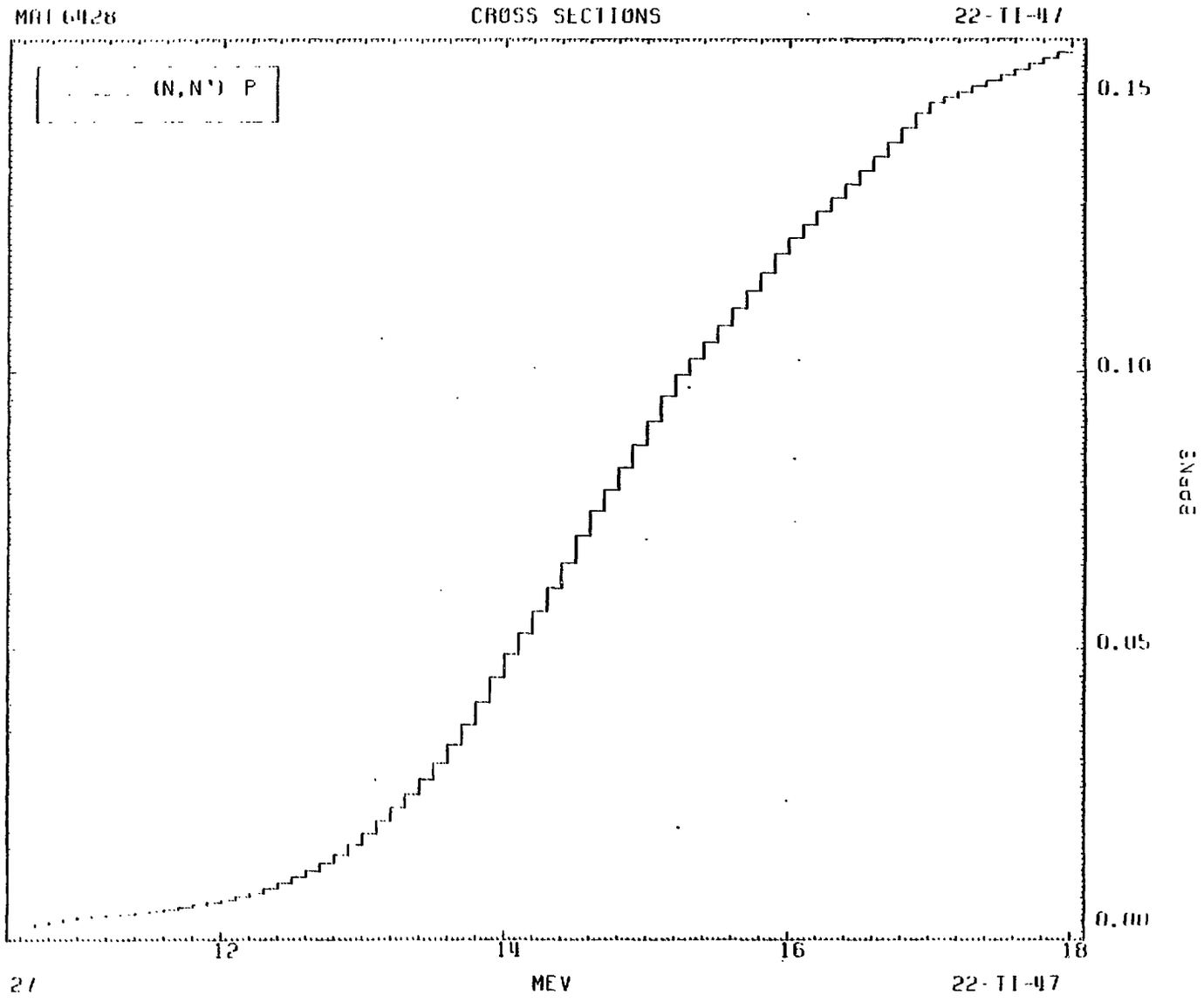

MAT 6399
CROSS SECTIONS
94-PU-239
FISSION
MEV
94-PU-239
22

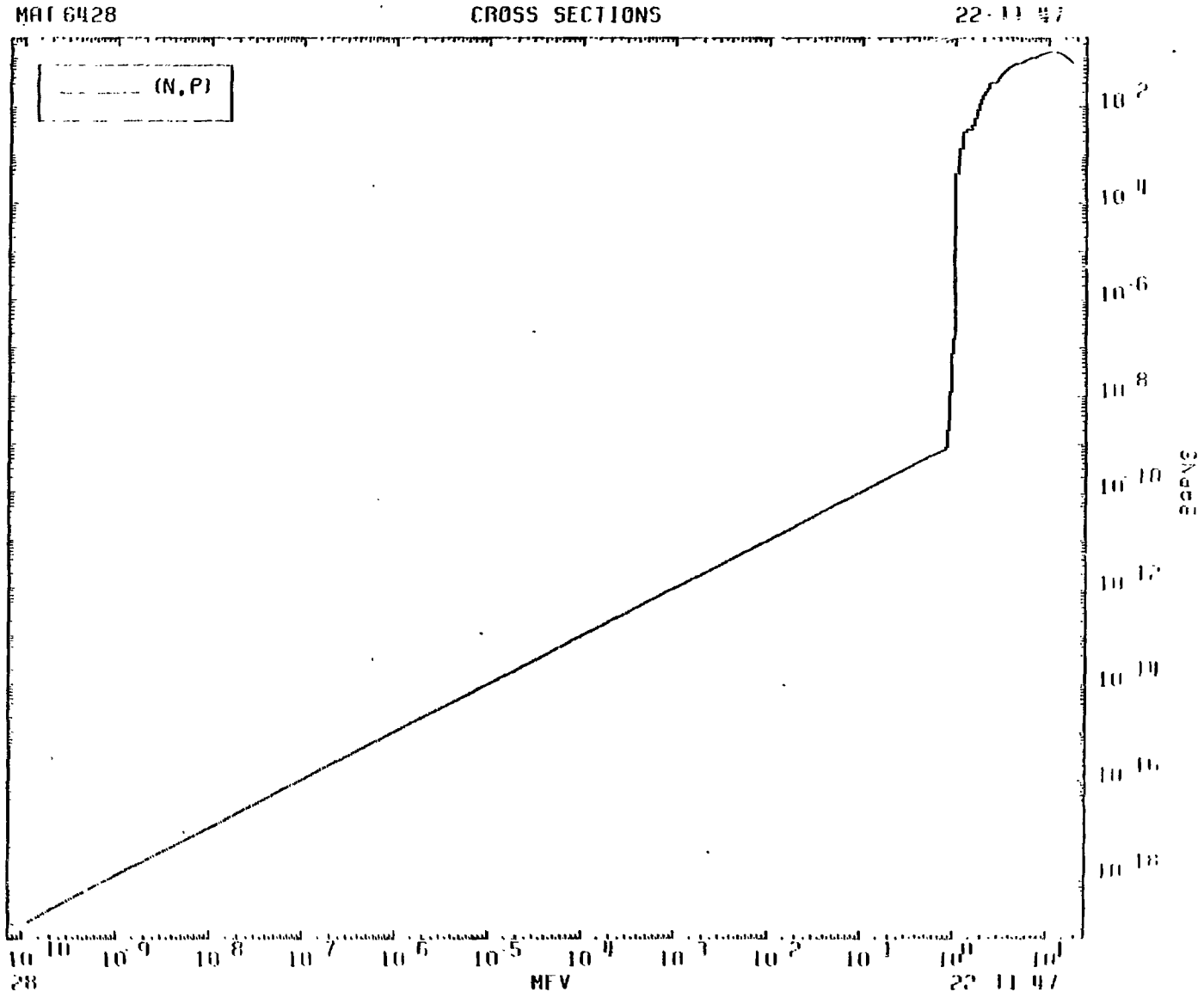

MAT 6424
CROSS SECTIONS
3-LI-6
10^{0}
5
10^{3}
5
10^{2}
5
10^{1}
5
10^{0}
BARNS
TOTAL HE-4 PRODUCTION
10^{-10} 10^{-9} 10^{-8} 10^{-7} 10^{-6} 10^{-5} 10^{-4} 10^{-3} 10^{-2} 10^{-1} 10^{0} 10^{1}
MEV
3-LI-6

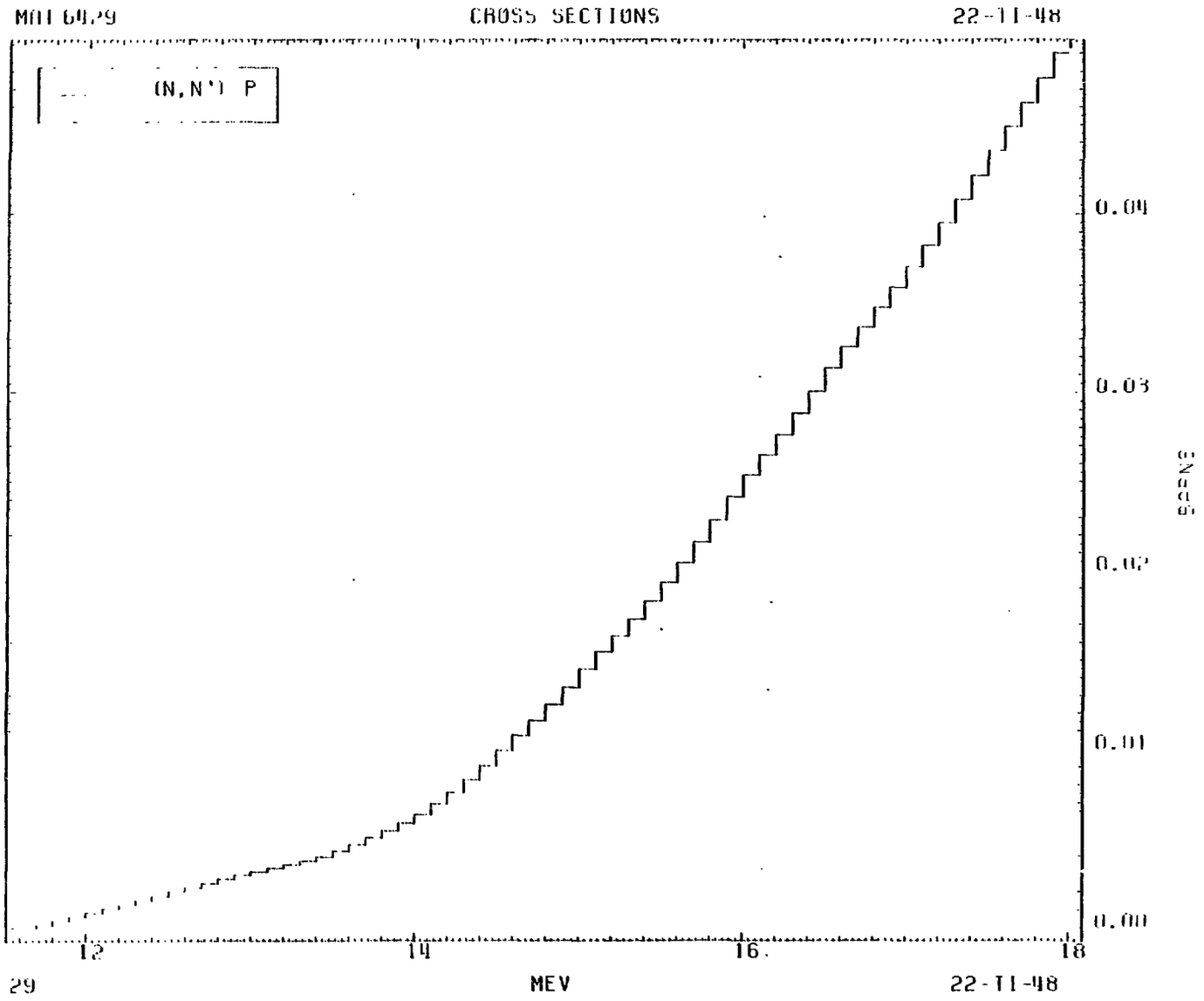

MAT 6425
CROSS SECTIONS
5-B -10
TOTAL NU-N PRODUCTION
MEV
BARNS

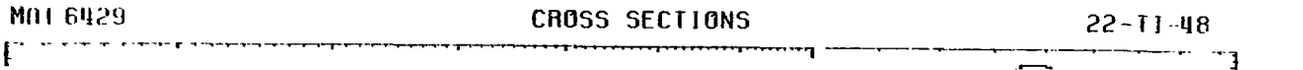

MAT 6426
CROSS SECTIONS
21-SC-45
5
10^{2}
5
10^{1}
5
10^{0}
5
10^{-1}
5
10^{-2}
5
10^{-3}
BARNS
(N,GAMMA)
10^{-10} 10^{-9} 10^{-8} 10^{-7} 10^{-6} 10^{-5} 10^{-4} 10^{-3} 10^{-2} 10^{-1} 10^{0} 10^{1}
25
MEV
21-SC 45

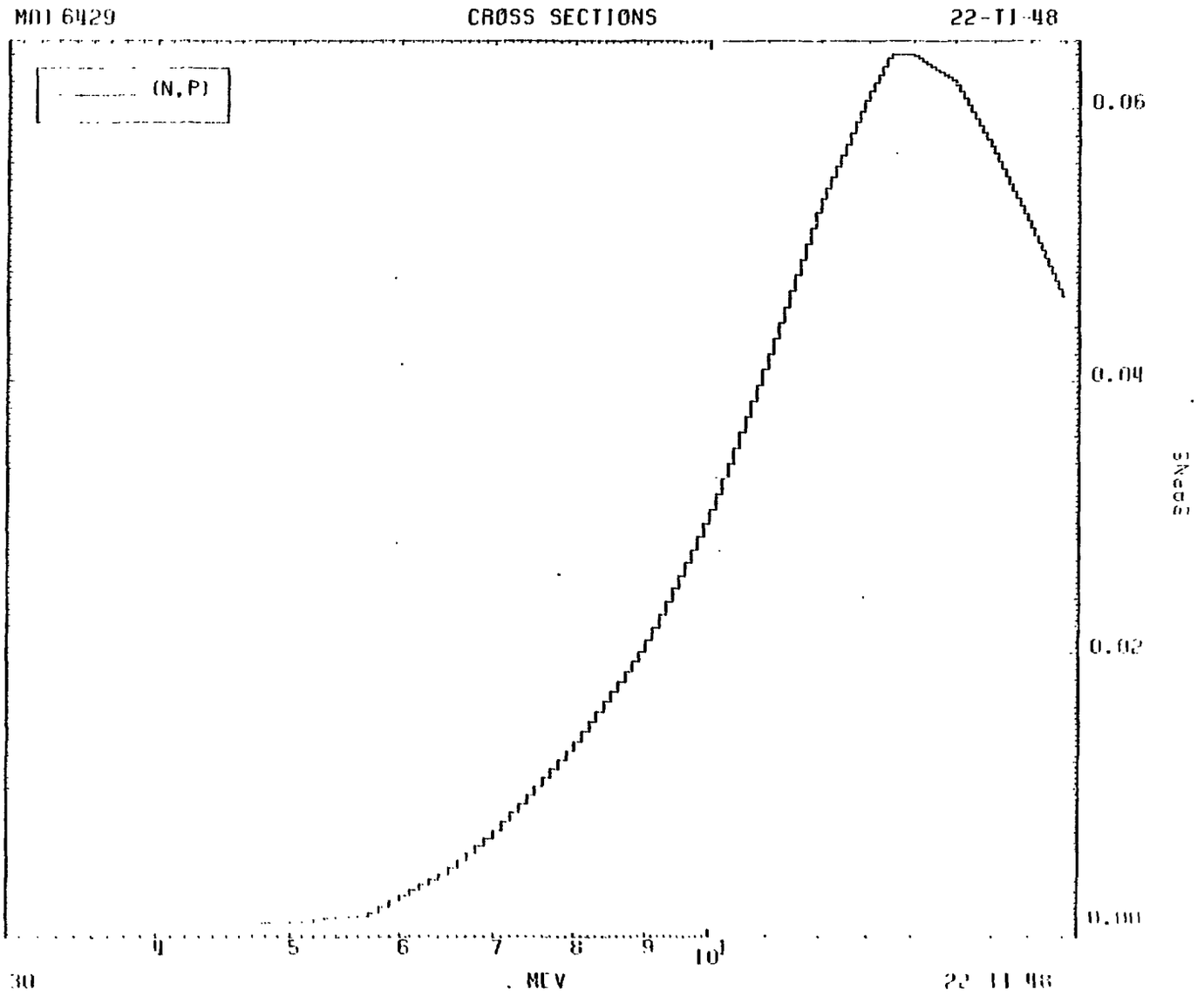

MAT 6427
CROSS SECTIONS
22-TI-46
(N,P)
0.25
0.20
0.15
0.10
0.05
0.00
barns
2
3
4
5
6
7
8
9
10
MEV
26
22 TI 46

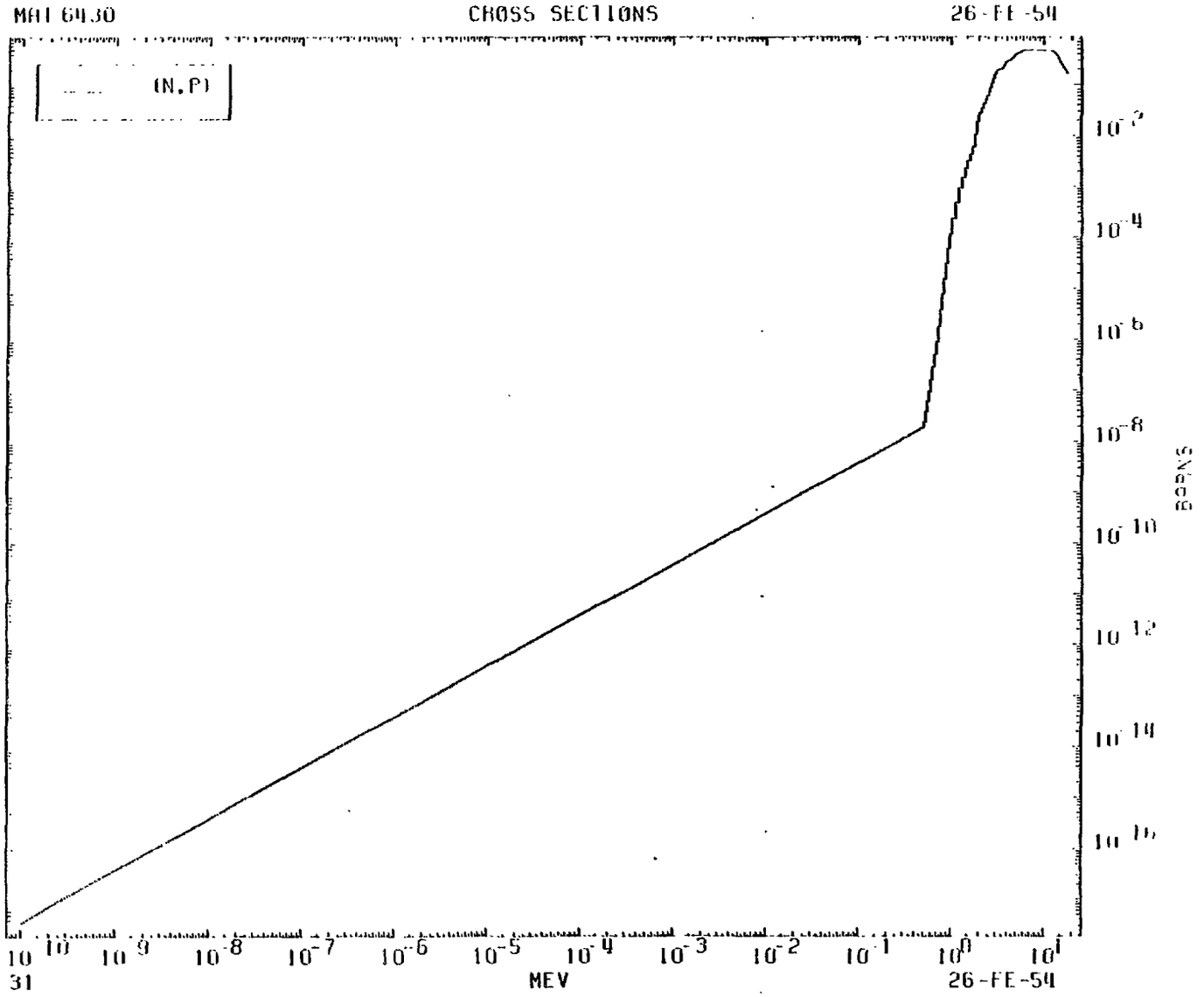

MAT 6428
CROSS SECTIONS
22-TI-47
(N,N') P
0.15
0.10
0.05
0.00
BARNS
12
14
16
18
27
MEV
22-TI-47

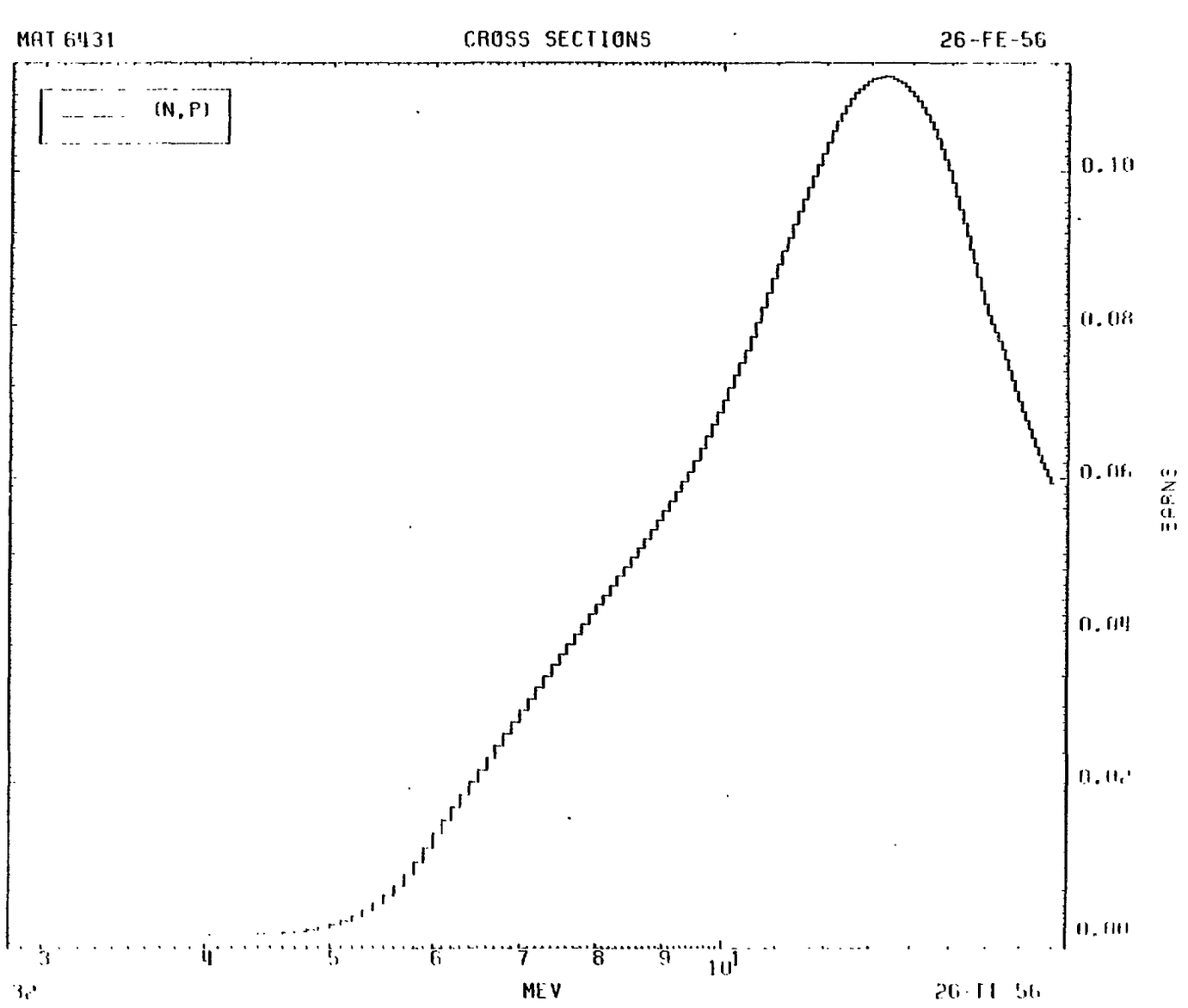

MAT 6428
CROSS SECTIONS
22-11-97
(N,P)
10 2
10 4
10 6
10 8
10 10
10 12
10 14
10 16
10 18
BARNS
10 10
10 9
10 8
10 7
10 6
10 5
10 4
10 3
10 2
10 1
10 0
10 1
28
MEV
22-11-97


MAT 6429
CROSS SECTIONS
22-TI-48
(N,N') P
0.04
0.03
0.02
0.01
0.00
BARNS
12
14
16
18
29
MEV
22-TI-48

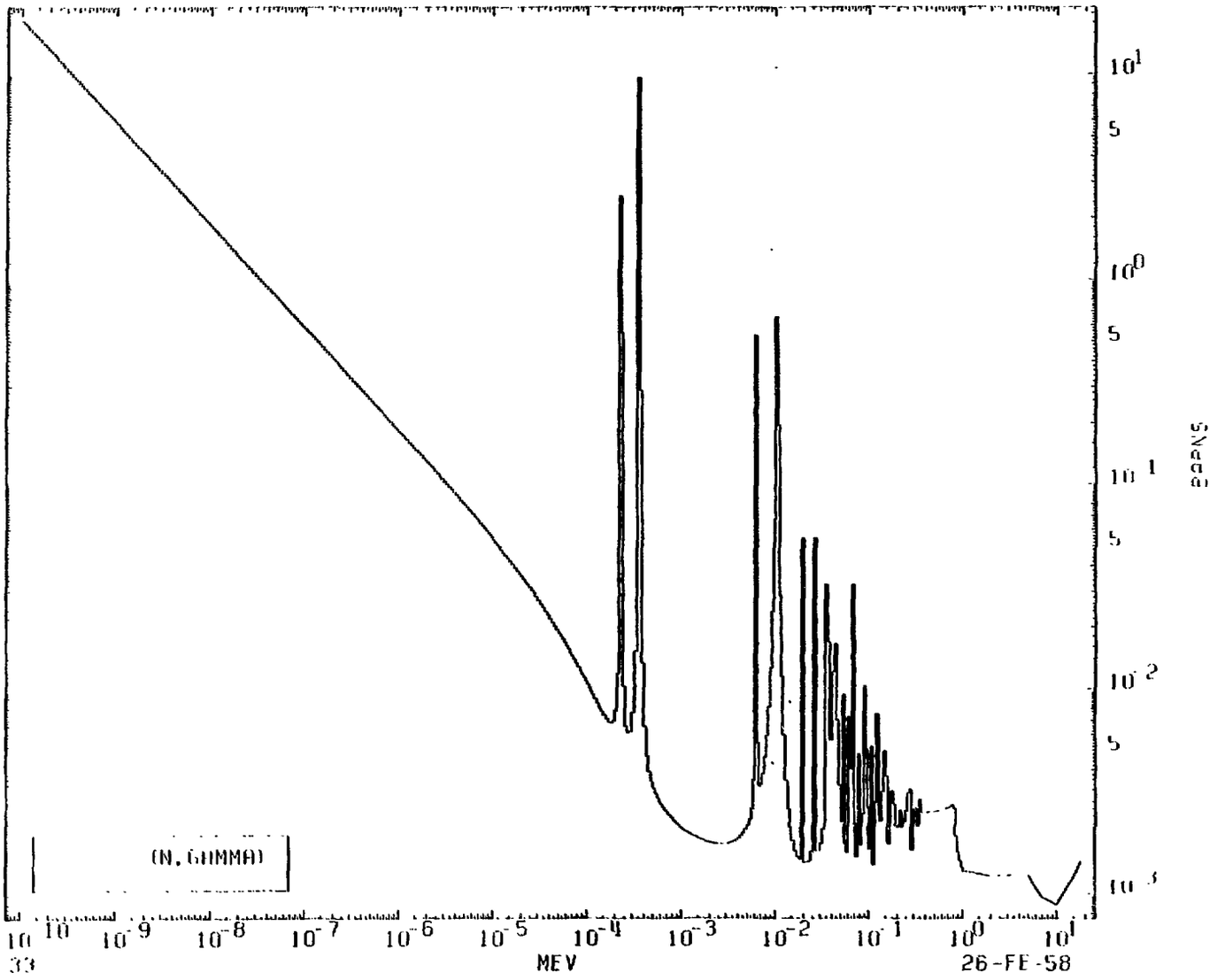

MAT 6429
CROSS SECTIONS
22-TI-48

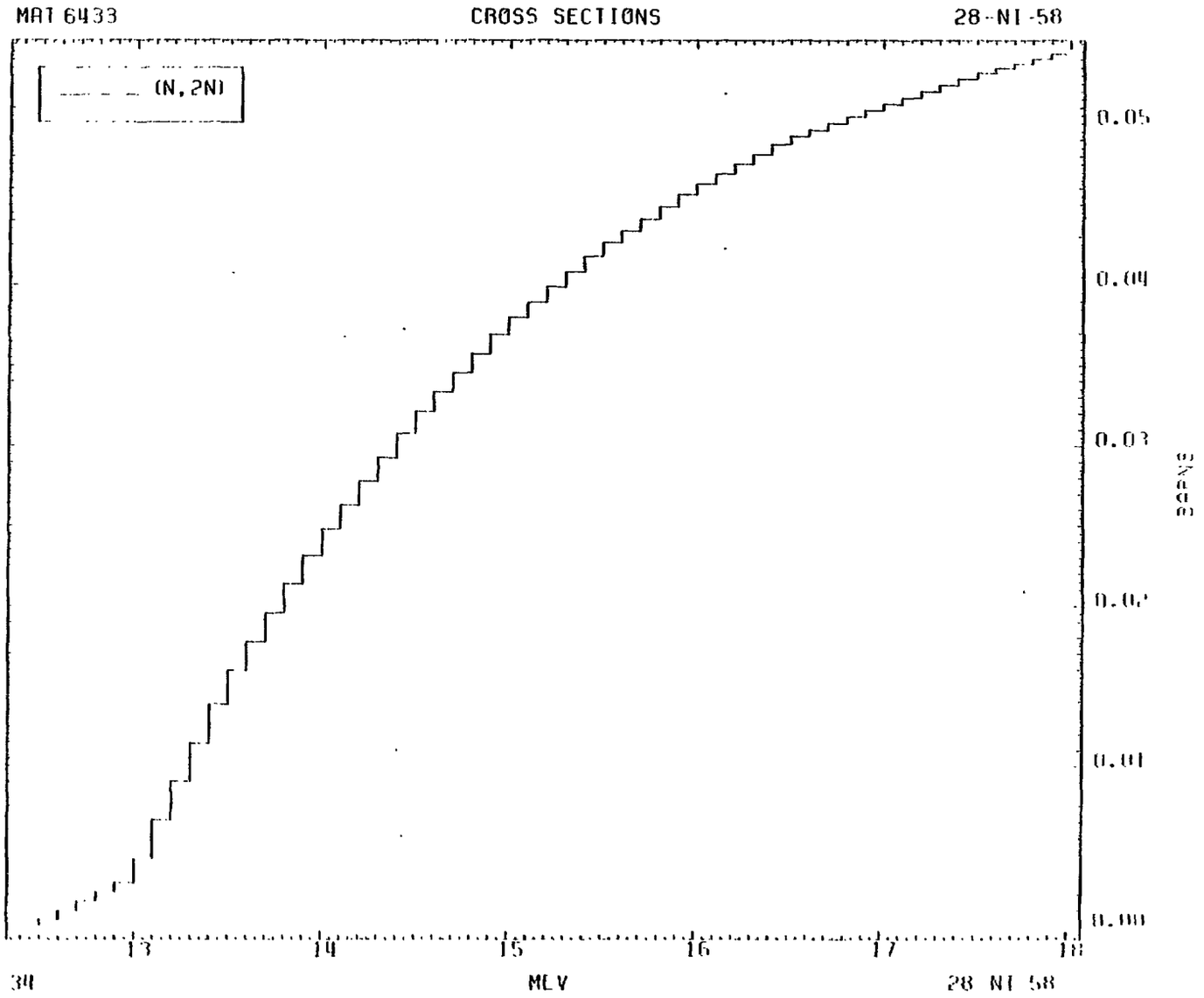

MOI 6429
CROSS SECTIONS
22-TI-48
(N,P)
0.06
0.04
0.02
0.00
BARNS
0
5
6
7
8
9
10
30
MEV
22 TI 48

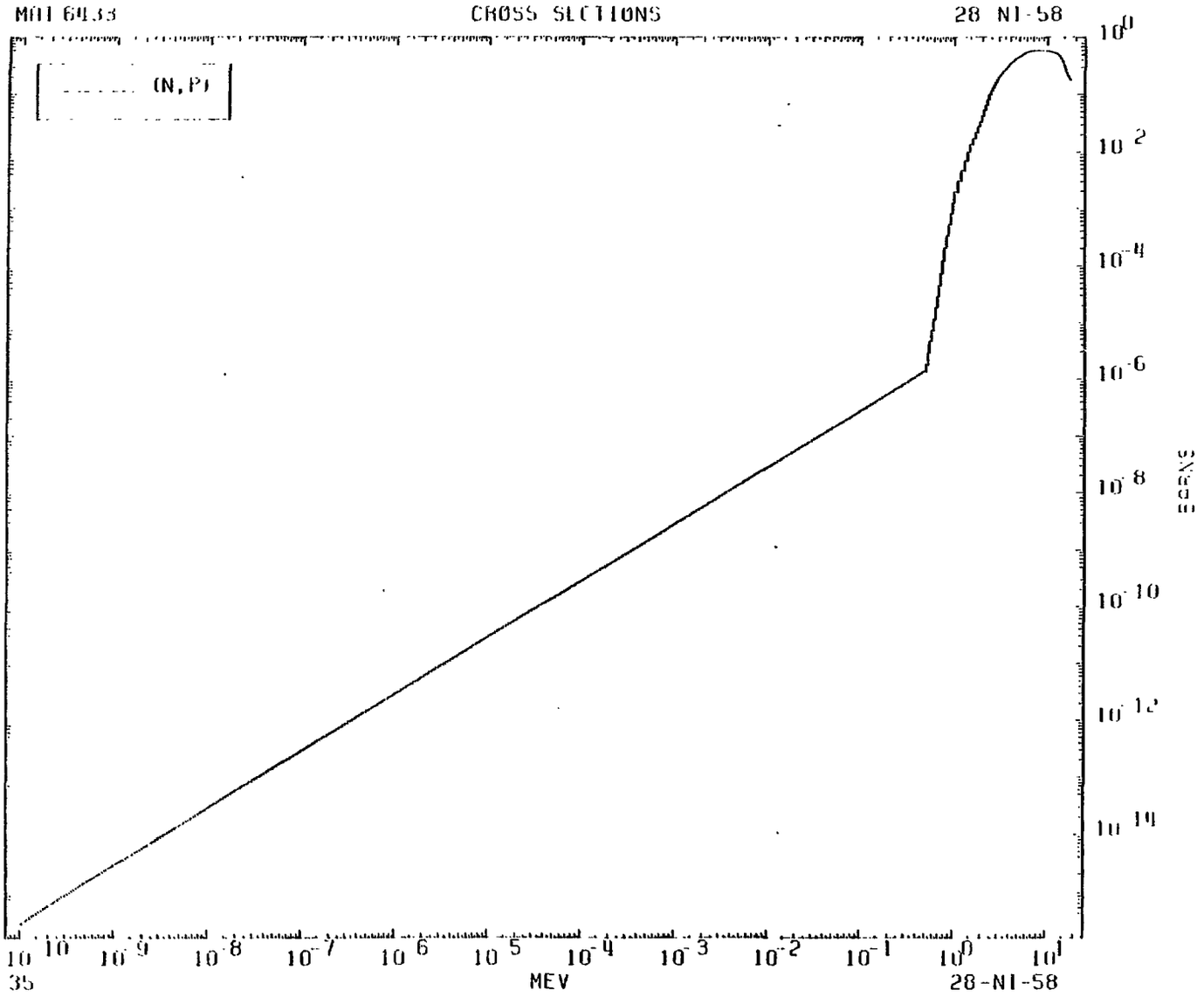

MAT 6430
CROSS SECTIONS
26-FE-54
(N,P)
BARNS
MEV
31
26-FE-54

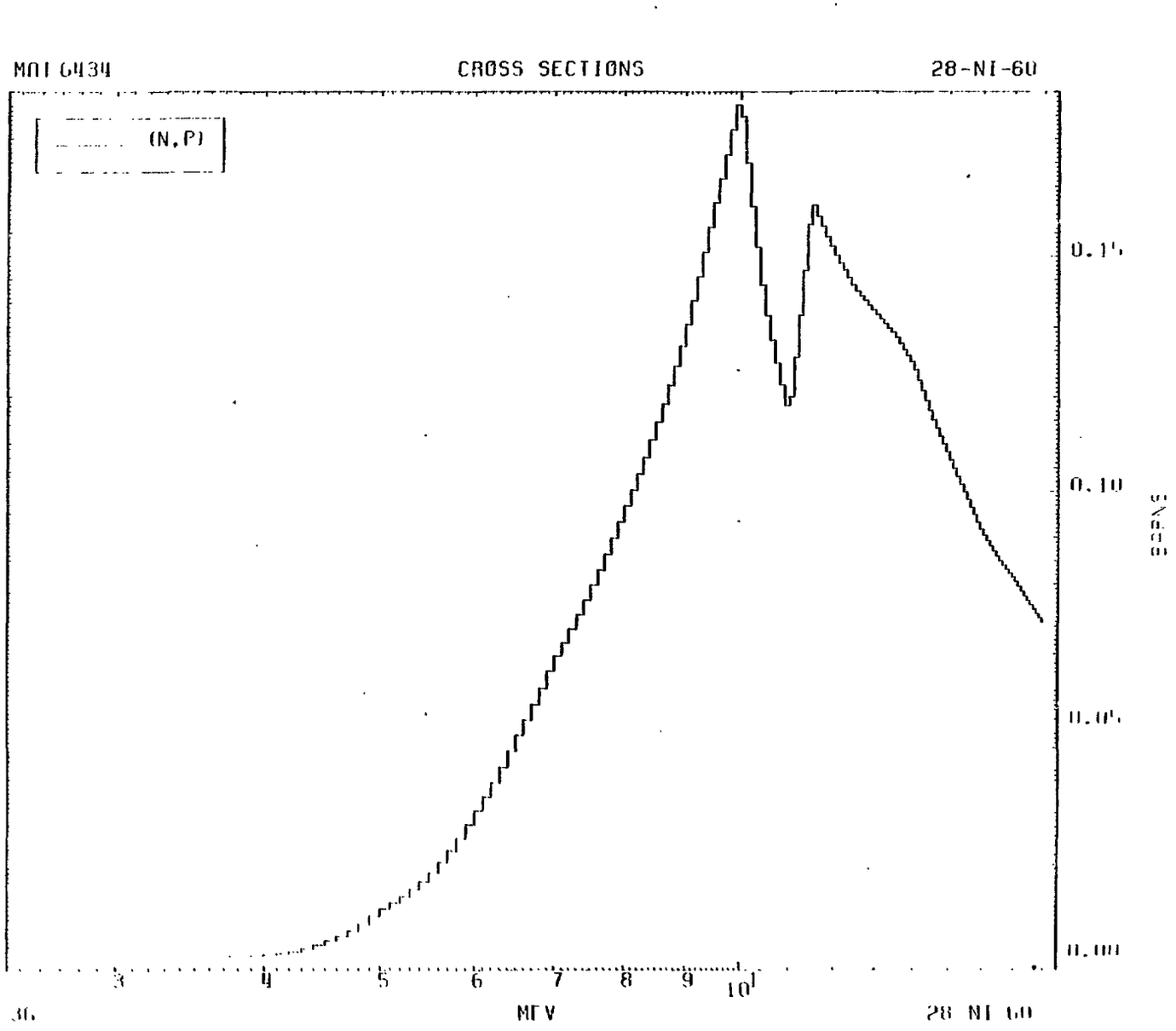

MAT 6431
CROSS SECTIONS
26-FE-56
(N,P)
0.10
0.08
0.06
0.04
0.02
0.00
BARNS
3
4
5
6
7
8
9
10
MEV
26-FE-56

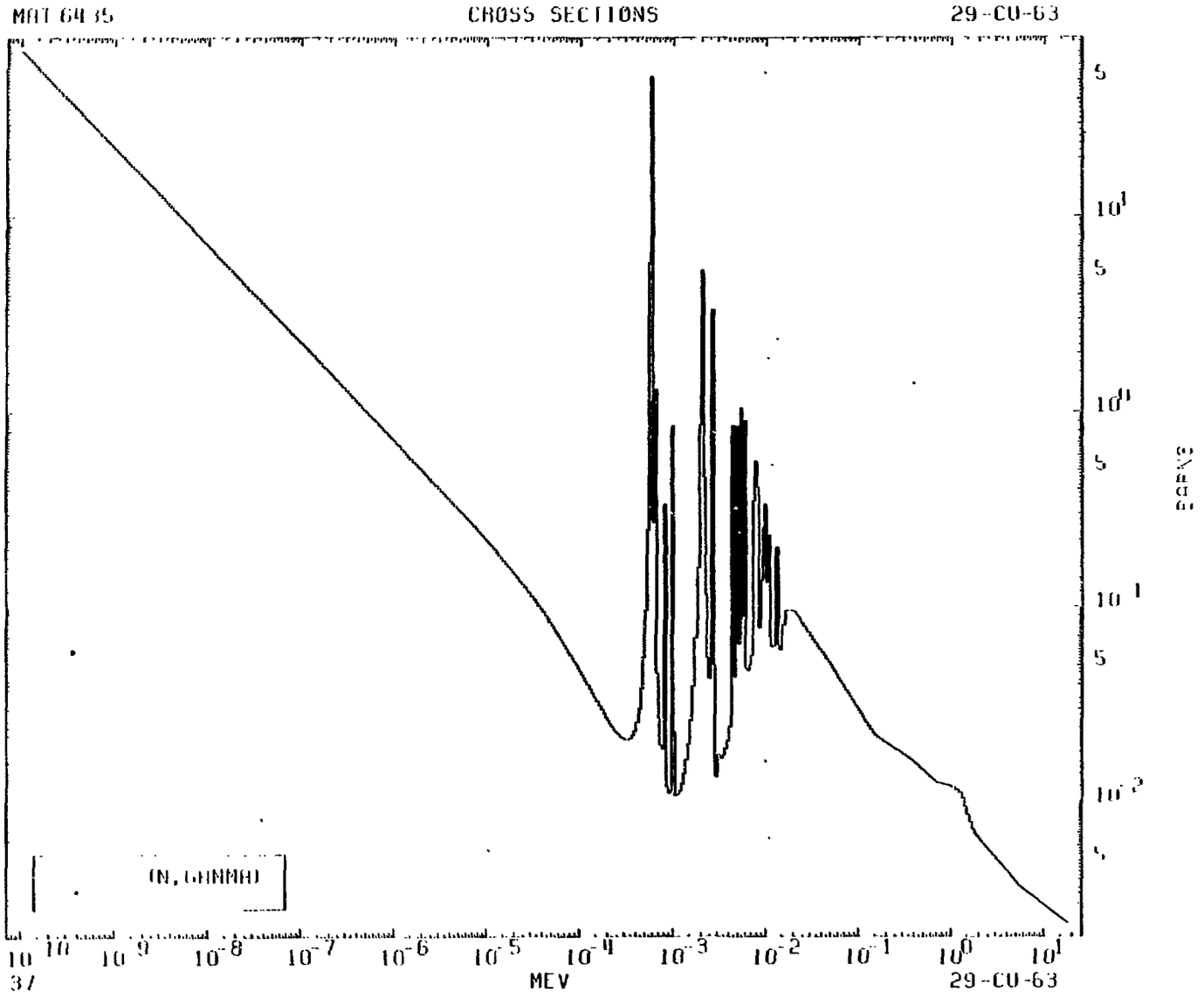
MAT 6432 CROSS SECTIONS 26-FE-58

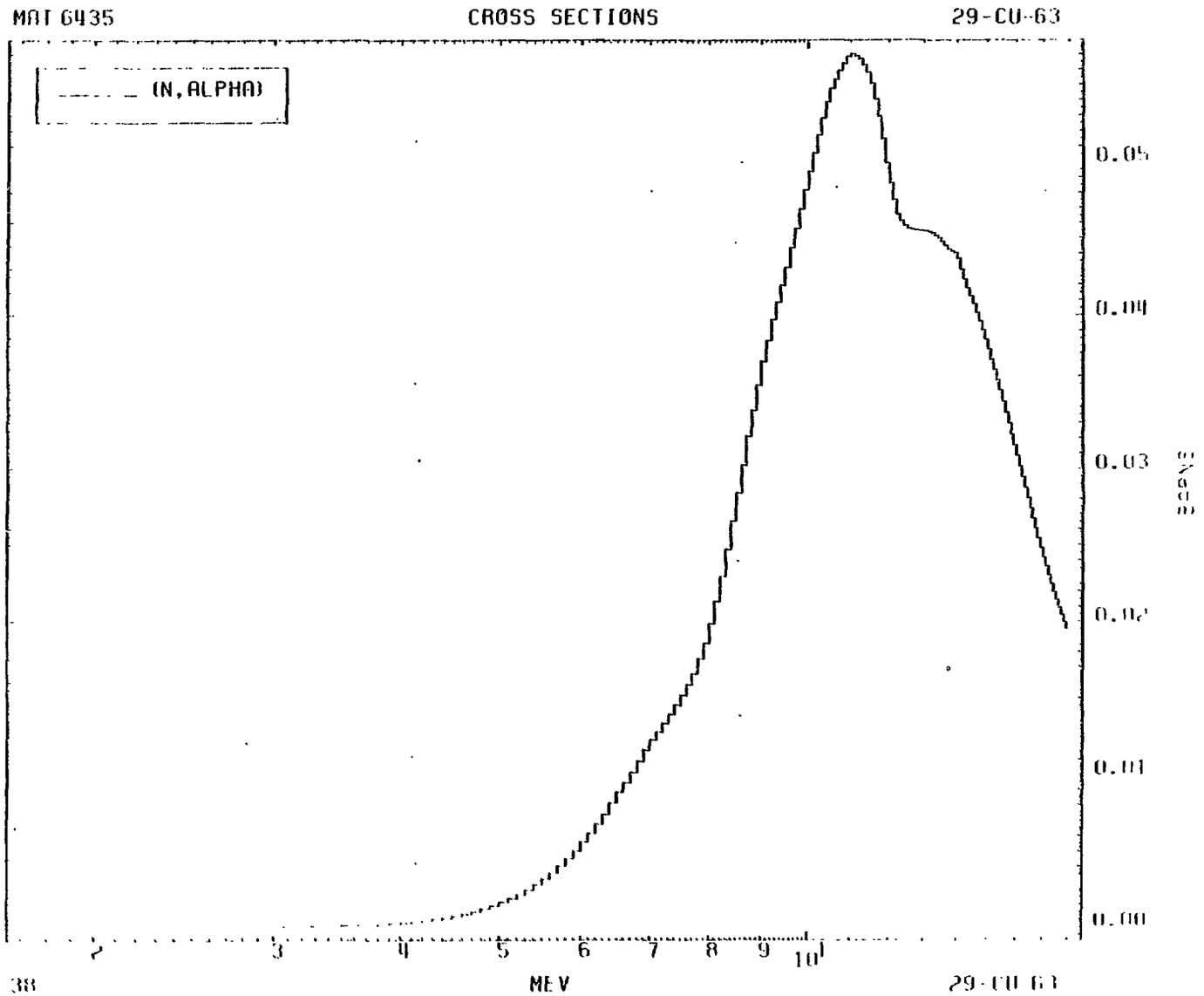


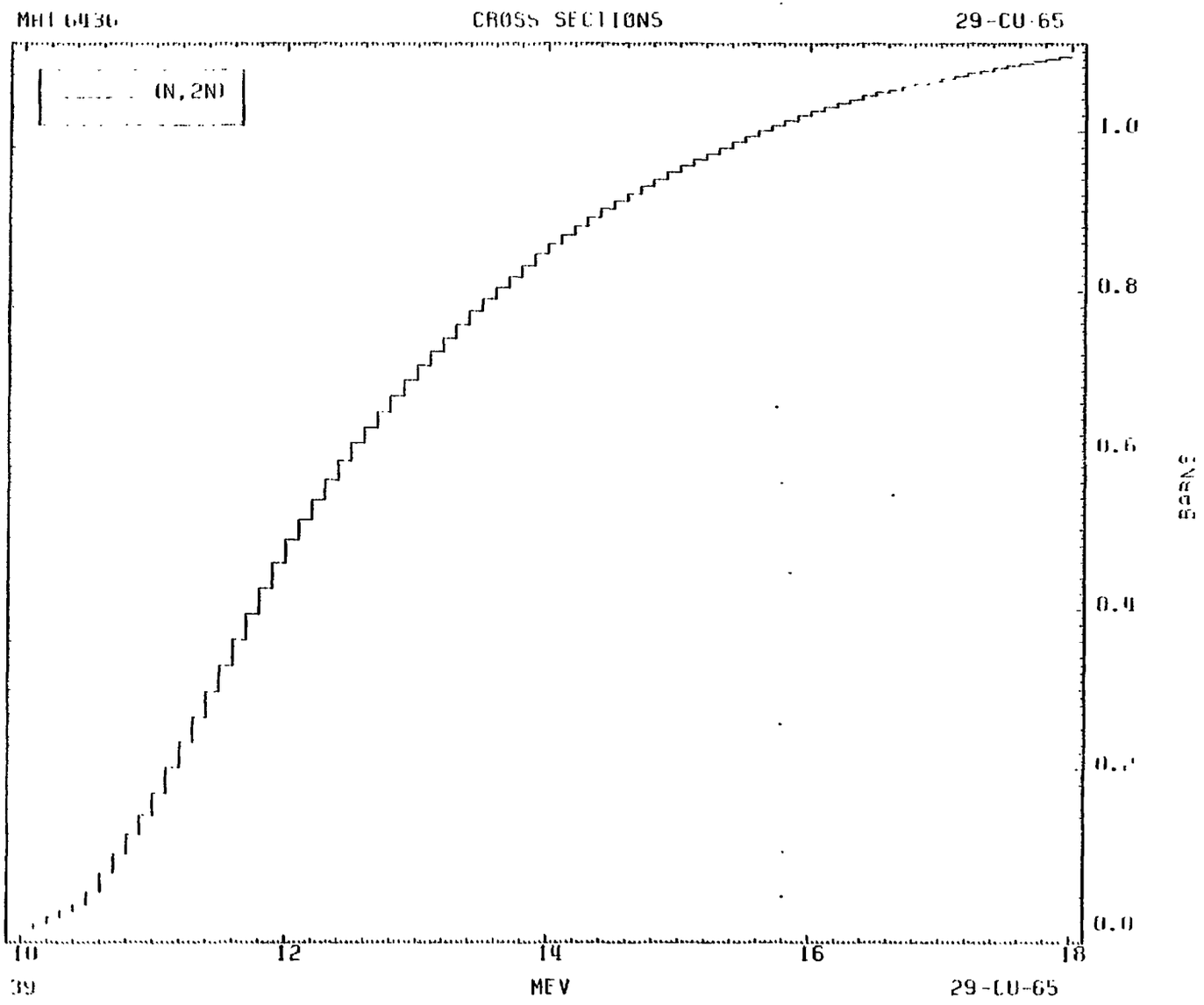

MAT 6433
CROSS SECTIONS
28-NI-58
(N,2N)
0.05
0.04
0.03
0.02
0.01
0.00
BARNS
13
14
15
16
17
18
30
MEV
28 NI 58

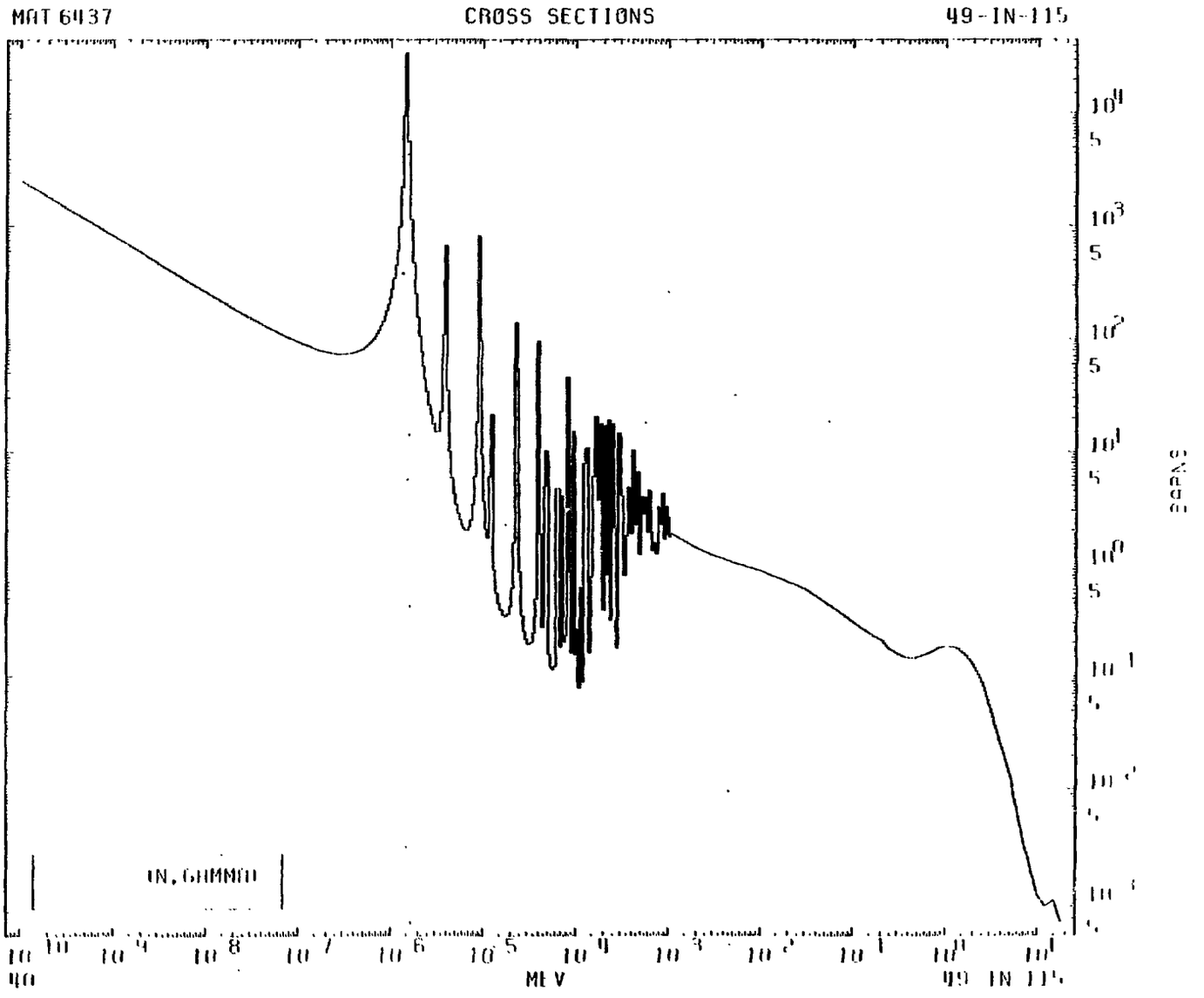

MAT 6433
CROSS SECTIONS
28 NI-58
(N,P)
BARNS
MEV
35
28-NI-58

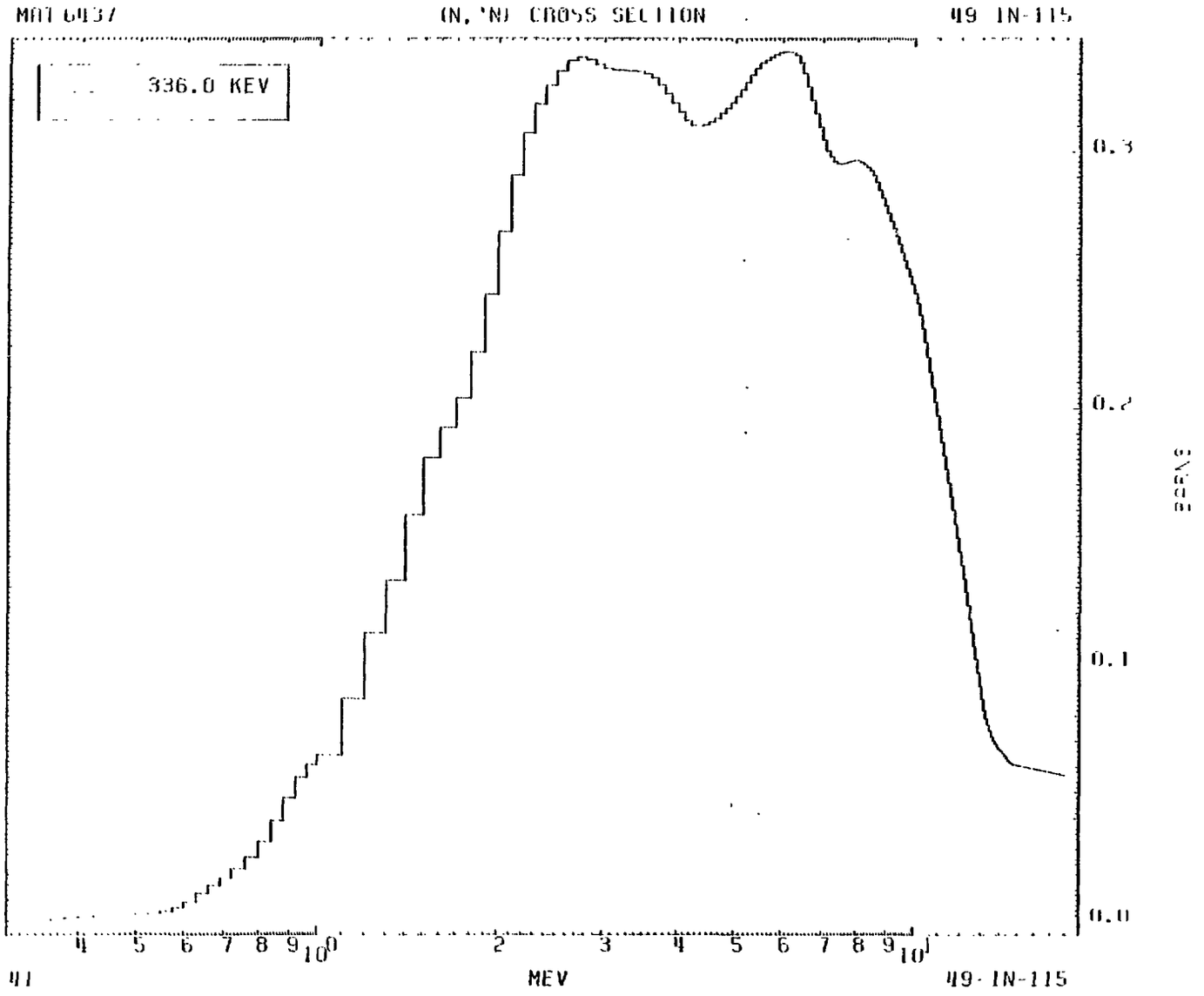

MAT 6434
CROSS SECTIONS
28-NI-60
(N,P)
0.15
0.10
0.05
0.00
BARNS
3
4
5
6
7
8
9
10
MEV
28 NI 60

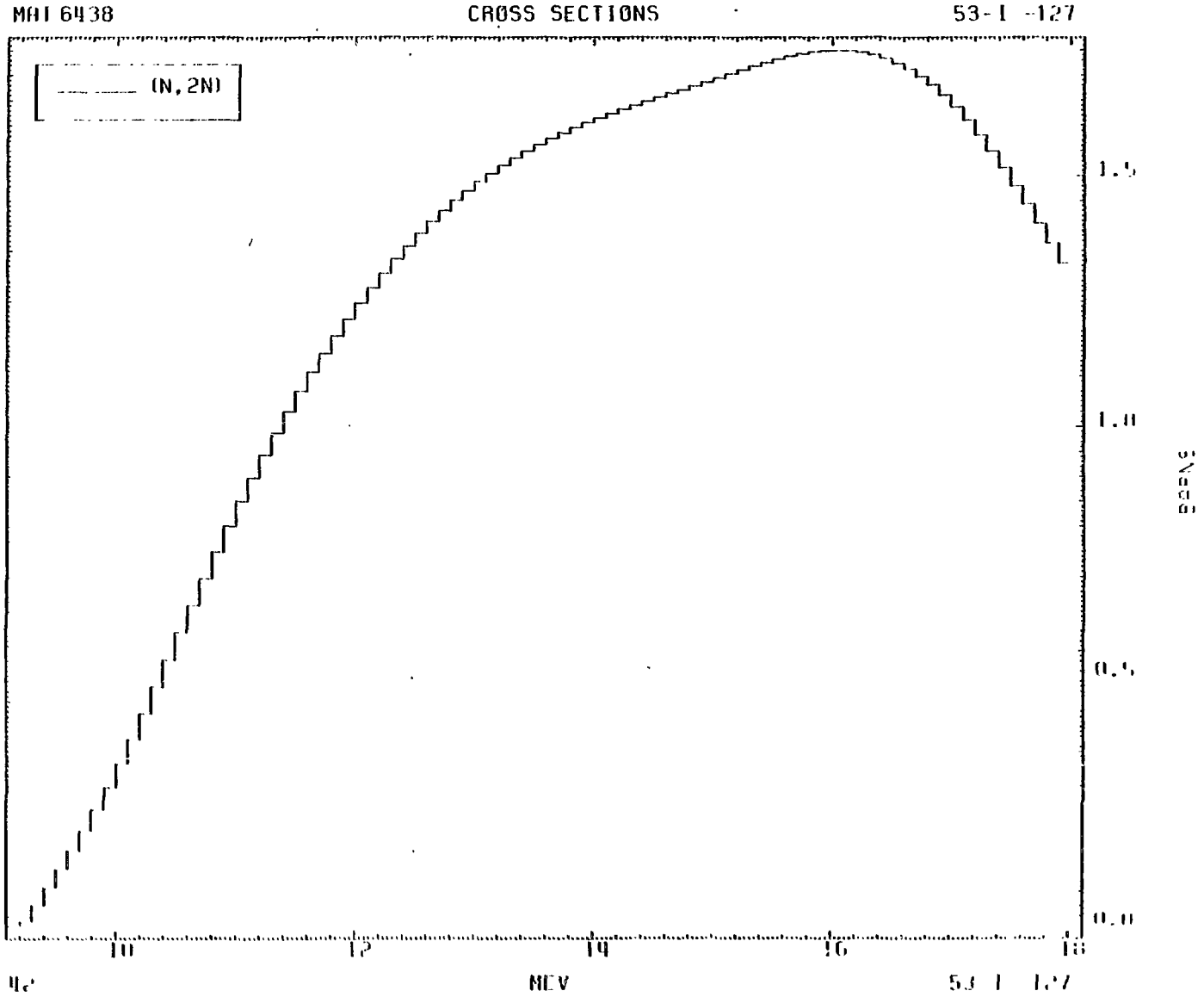

MAT 6435
CROSS SECTIONS
29-CU-63
5
10^{1}
5
10^{0}
5
10^{-1}
5
10^{-2}
5
BARNS
(N,GAMMA)
10^{-10} 10^{-9} 10^{-8} 10^{-7} 10^{-6} 10^{-5} 10^{-4} 10^{-3} 10^{-2} 10^{-1} 10^{0} 10^{1}
37
MEV
29-CU-63

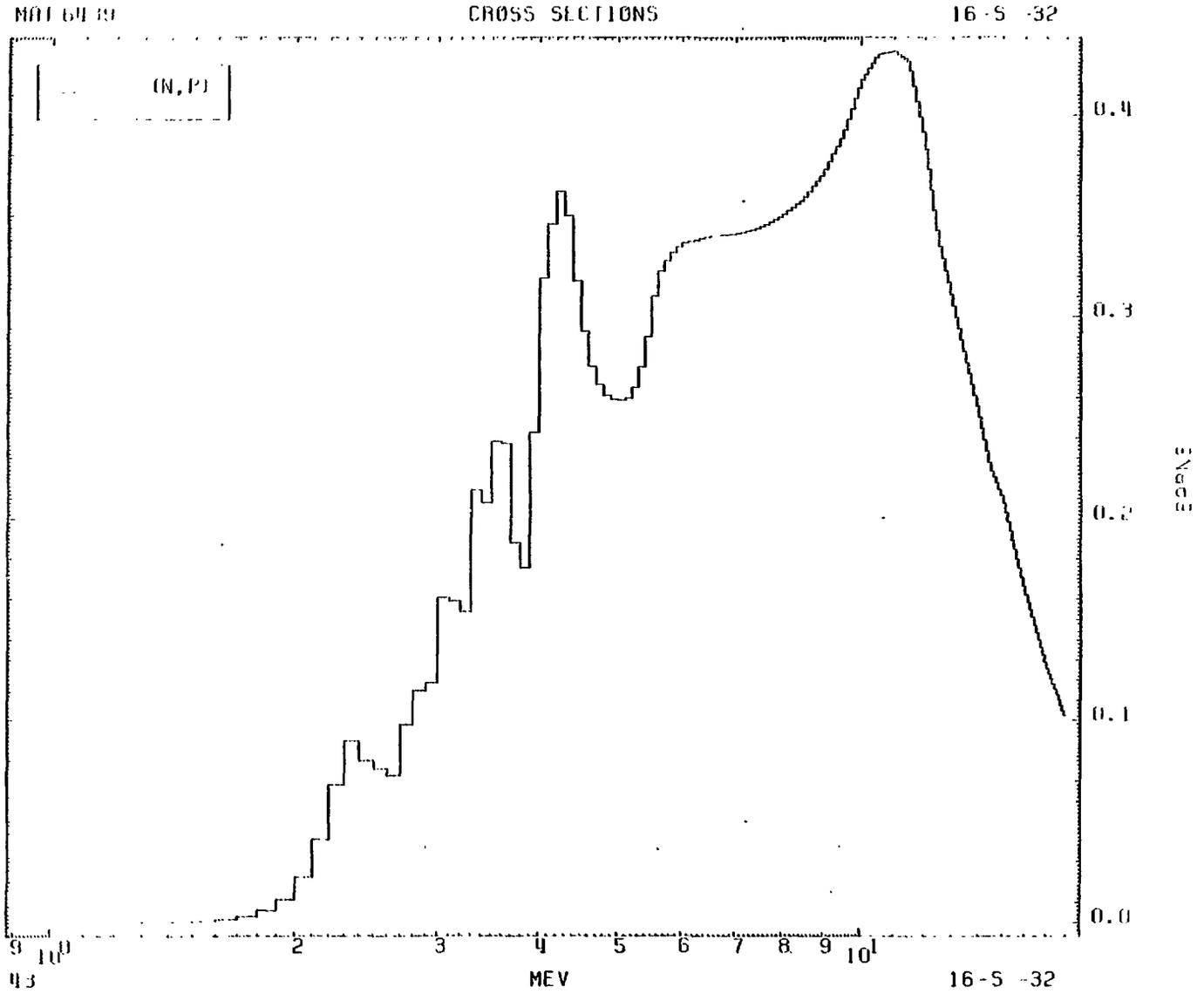

MAT 6435
CROSS SECTIONS
29-CU-63
(N,ALPHA)
0.05
0.04
0.03
0.02
0.01
0.00
BARNS
2
3
4
5
6
7
8
9
10
MEV
29-CU-63

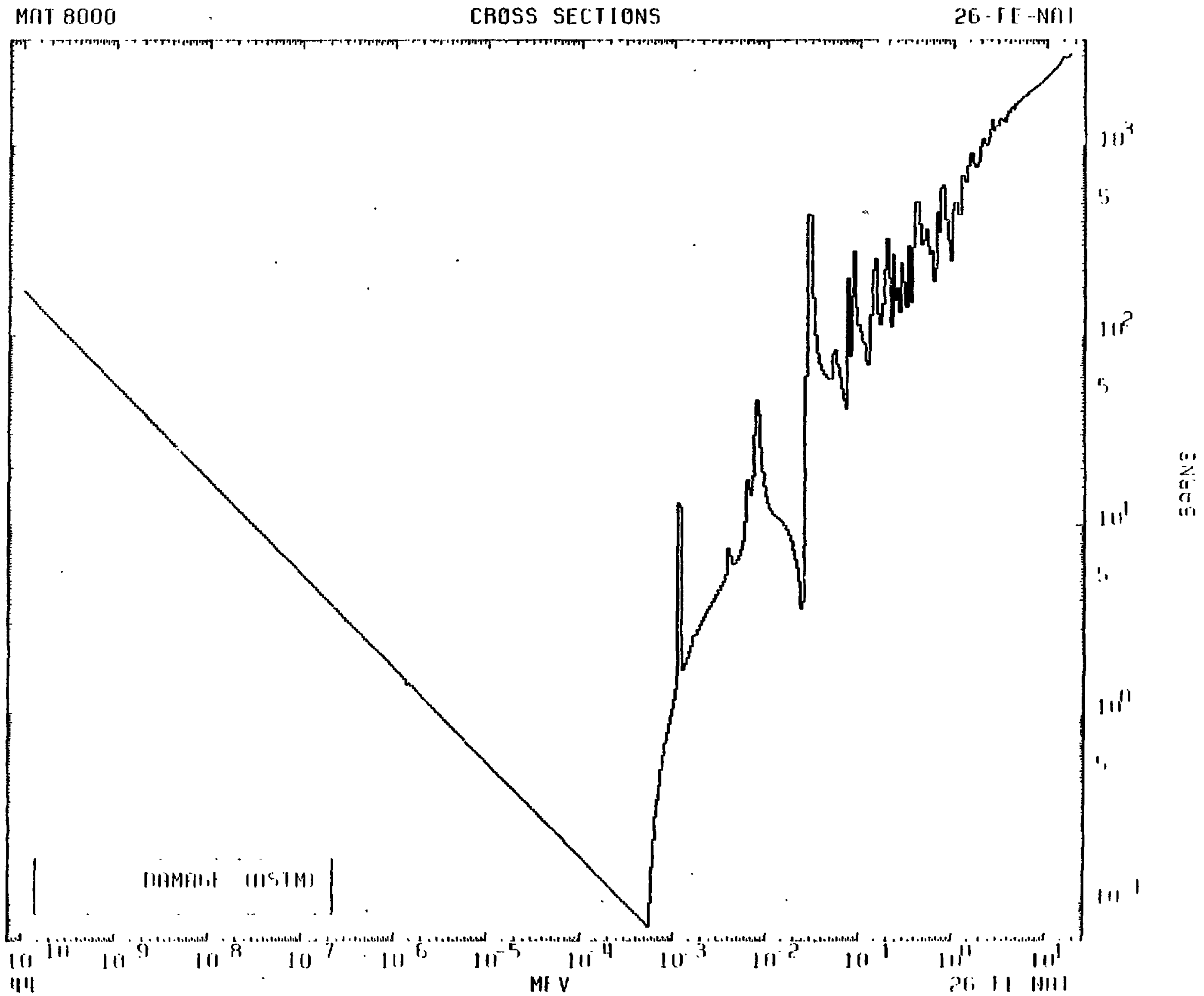

MHT 6436
CROSS SECTIONS
29-CU-65
(N,2N)
1.0
0.8
0.6
0.4
0.2
0.0
BARNS
10
12
14
16
18
MEV
29-CU-65


MAT 6037
CROSS SECTIONS
49-IN-115
BARNS
IN,GAMMA
MEV
49 IN 115

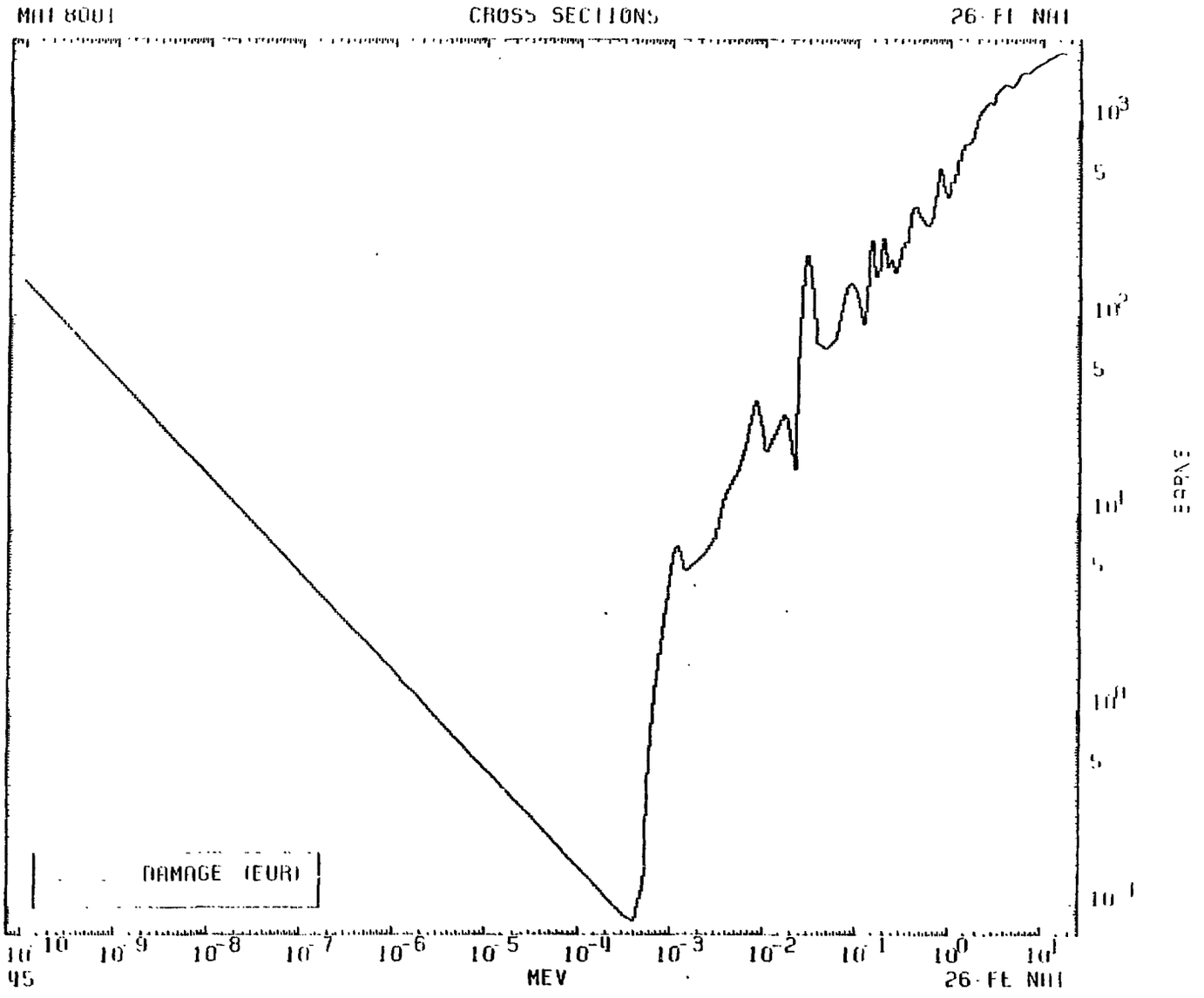

MAT 6437
(N,'N) CROSS SECTION
49 IN-115
336.0 KEV
0.3
0.2
0.1
0.0
BARNS
4 5 6 7 8 9 10^0 2 3 4 5 6 7 8 9 10^1
41
MEV
49-IN-115


MAT 6438
CROSS SECTIONS
53-I -127
(N,2N)
1.5
1.0
0.5
0.0
BARNS
10
12
14
16
18
MEV
53 I 127

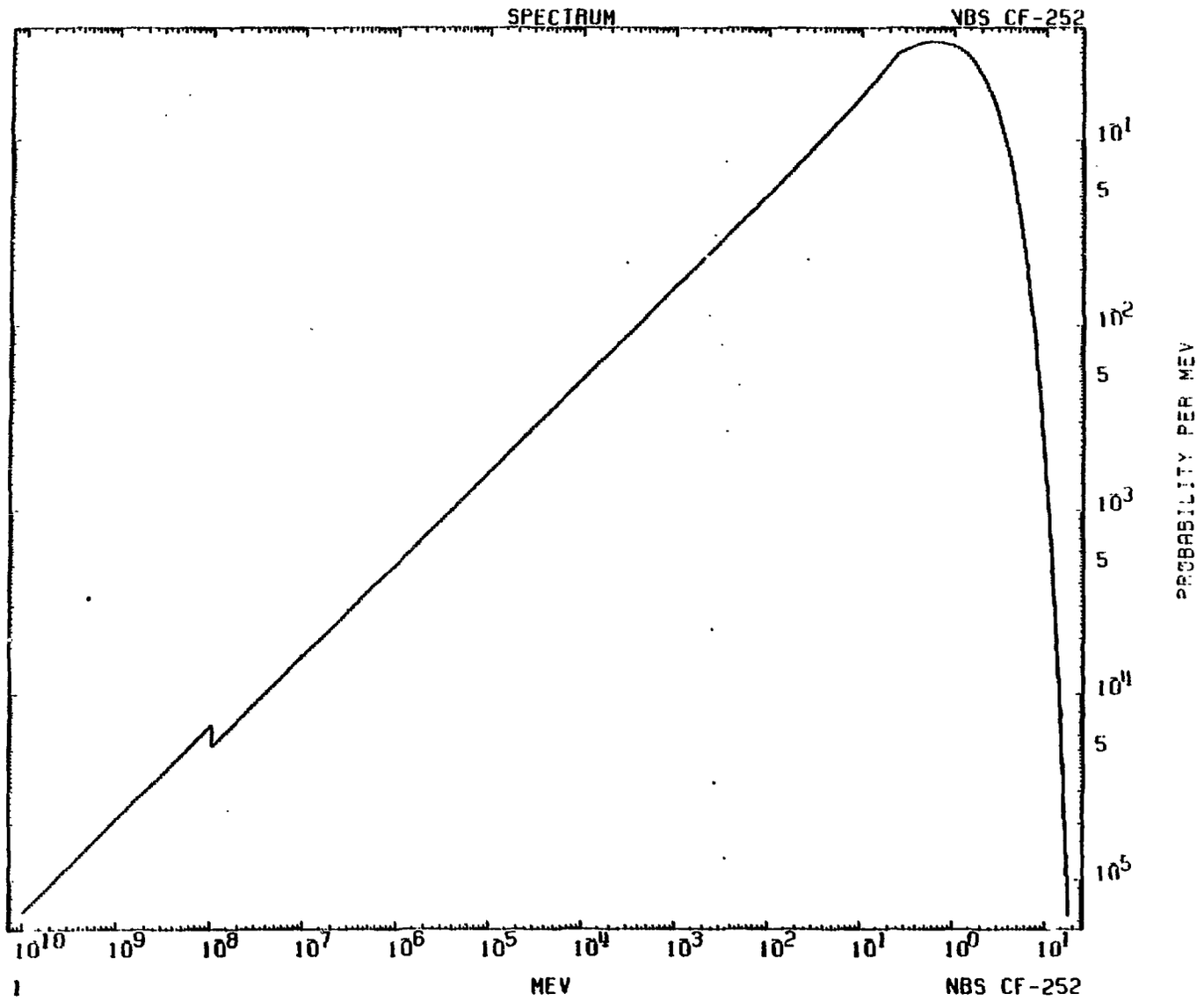

MAT 6439
CROSS SECTIONS
16-S -32
(N,P)
0.4
0.3
0.2
0.1
0.0
BARNS
9
10^0
2
3
4
5
6
7
8
9
10^1
MEV
16-S -32



MAT 8000
CROSS SECTIONS
26-FE-NAT
DAMAGE (ASTM)
MEV
BARNS
26-FE-NAT

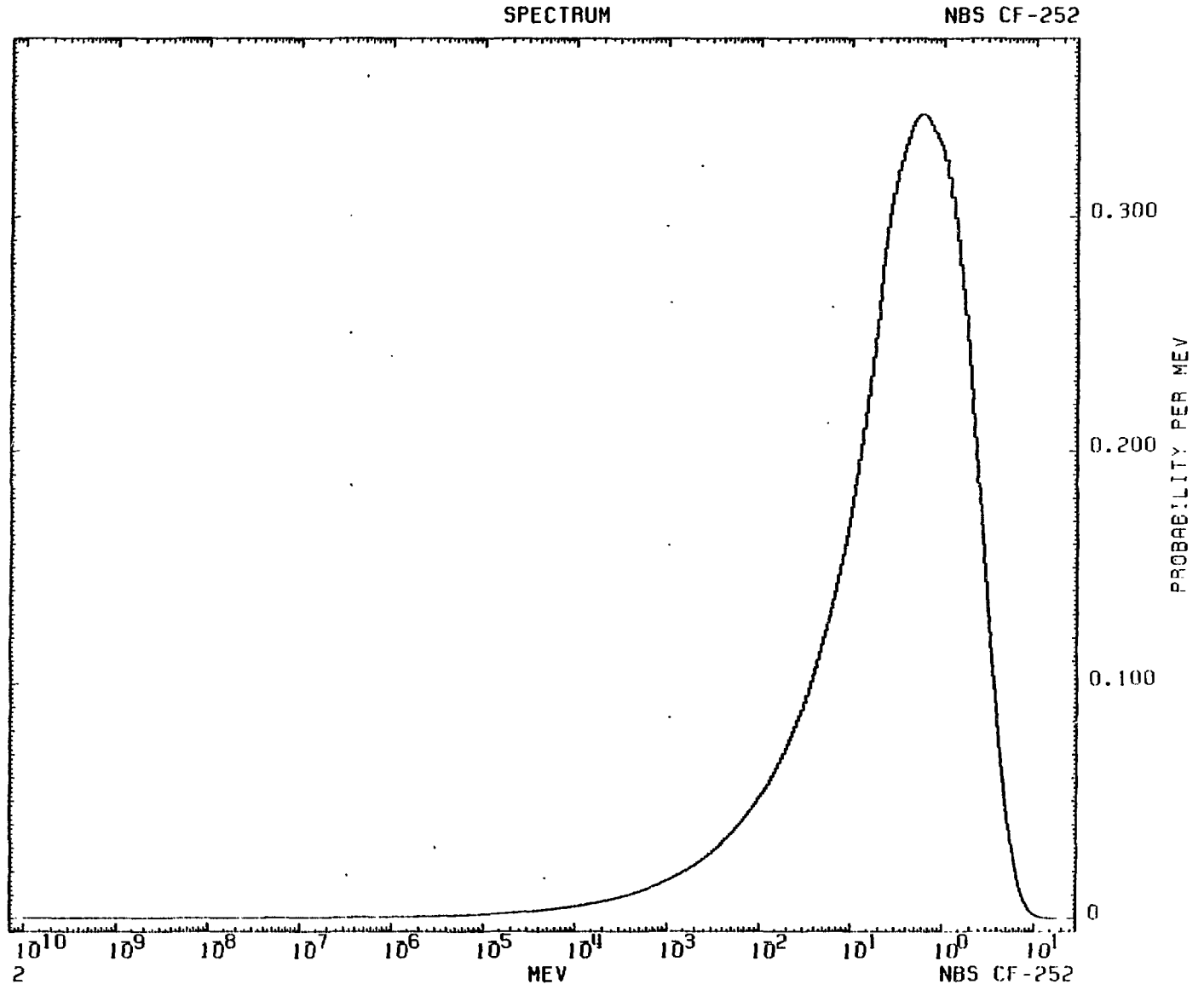

MAT 8001
CROSS SECTIONS
26-FE NAT
DAMAGE (EUR)
MEV
26-FE NAT

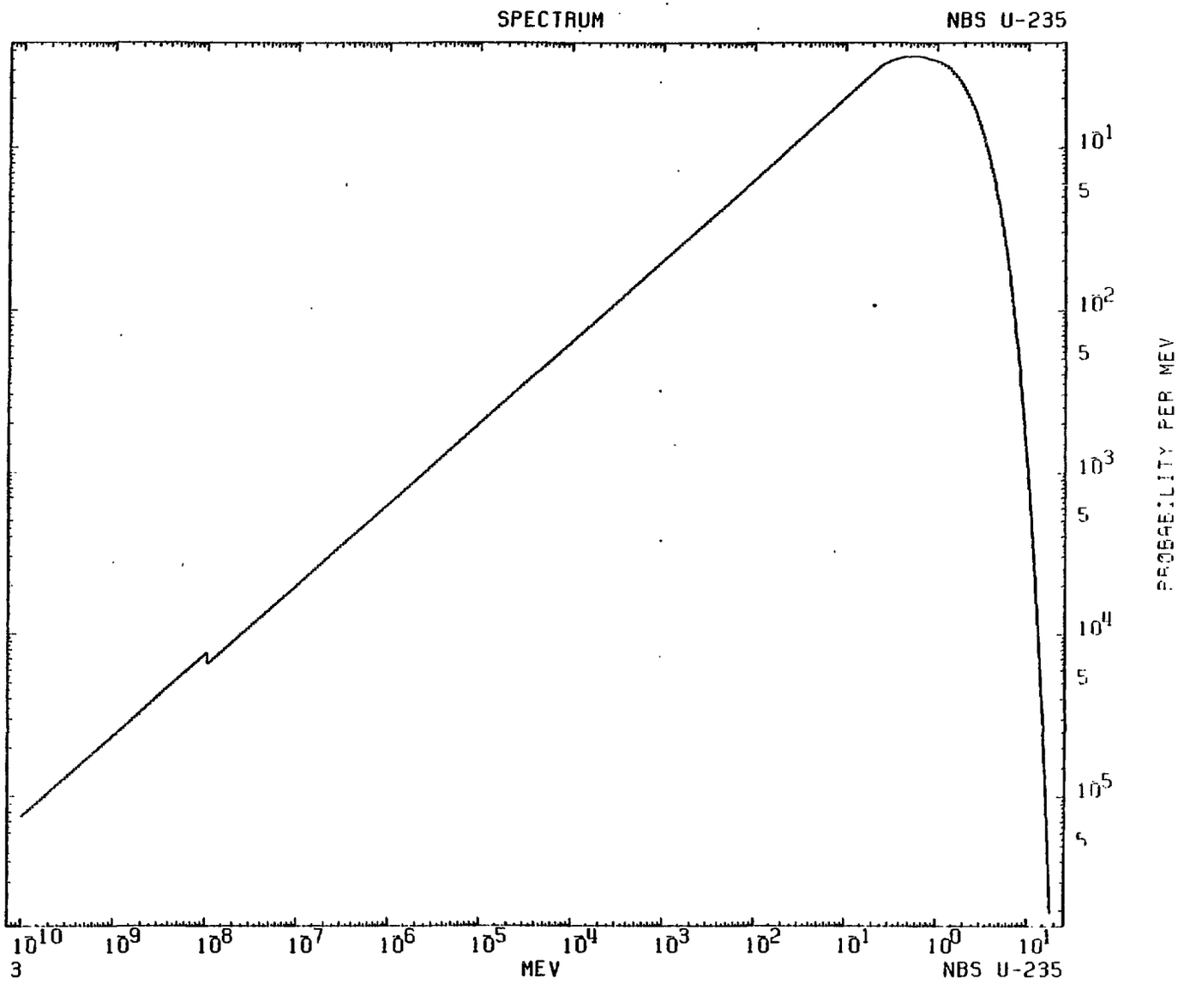
X. Plots of Benchmark Spectra

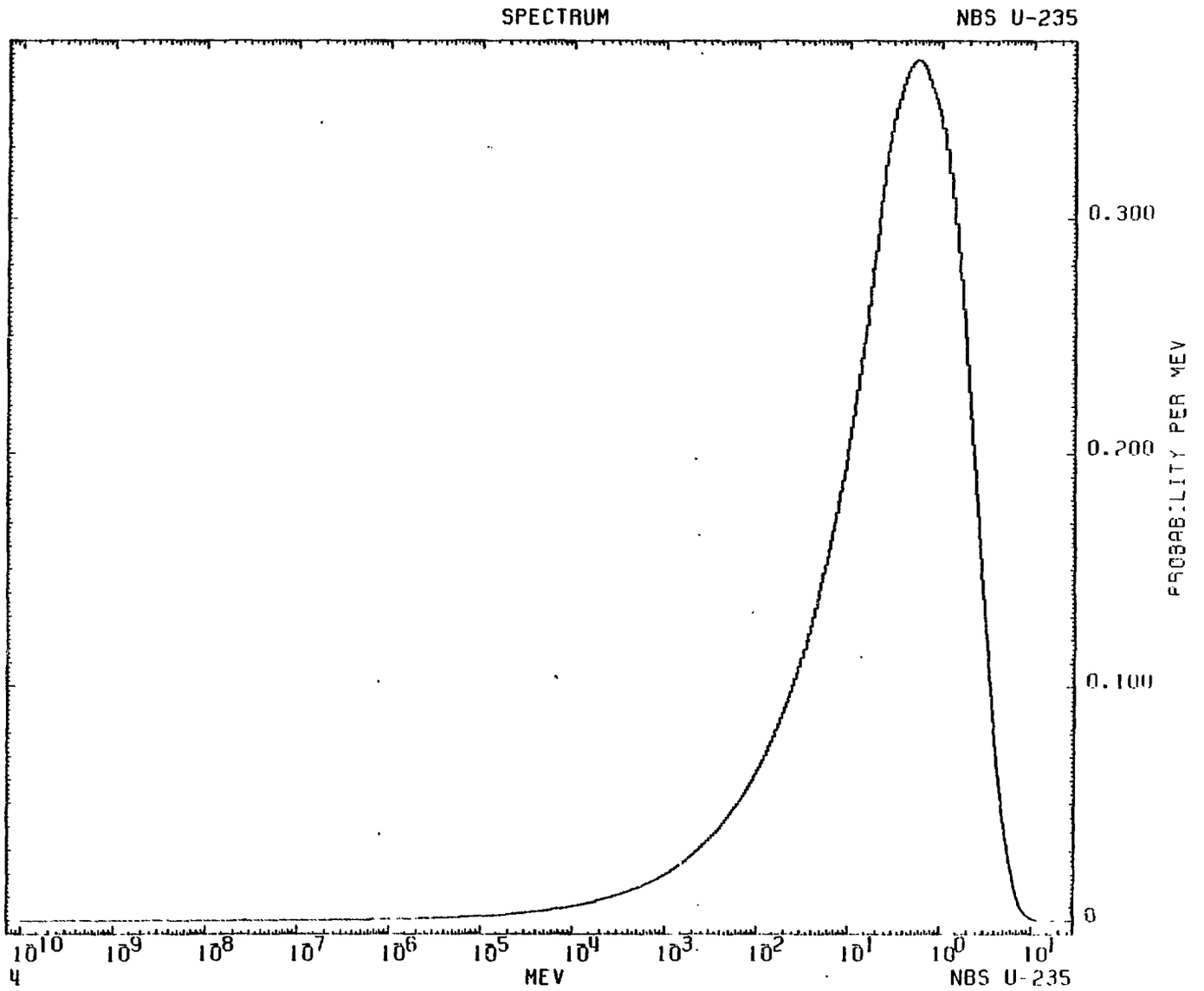


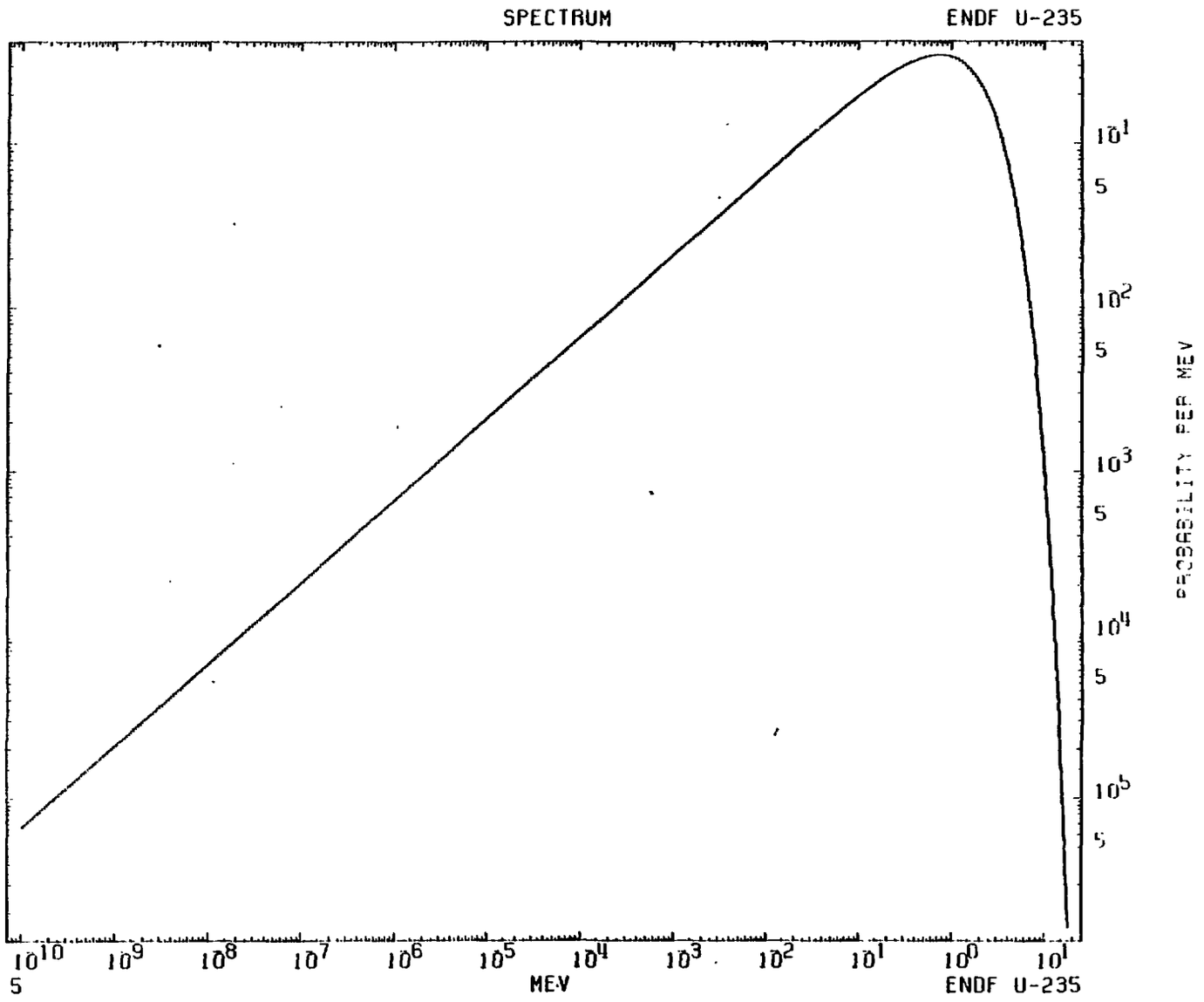
SET 00127

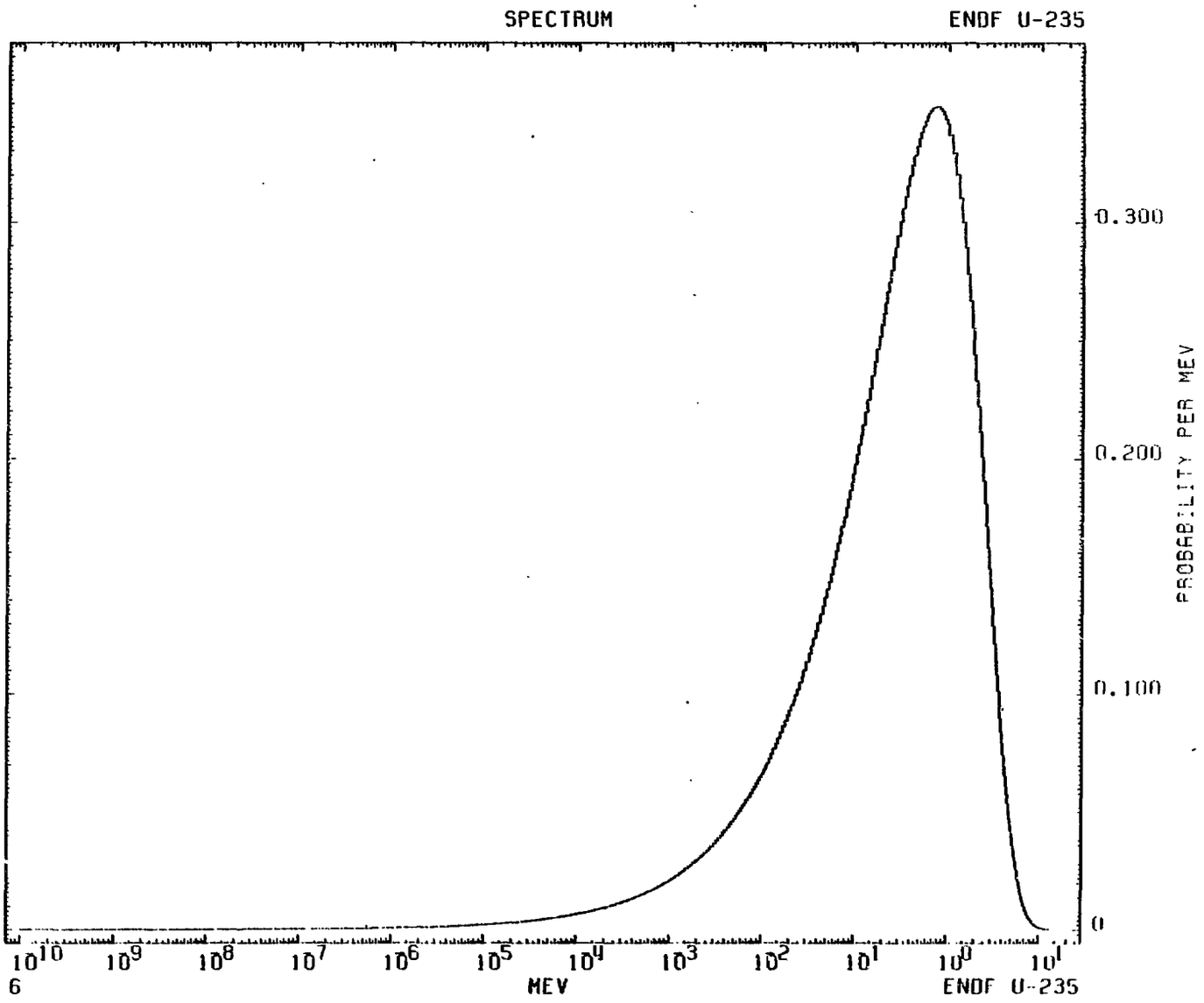
SPECTRUM NBS CF-252

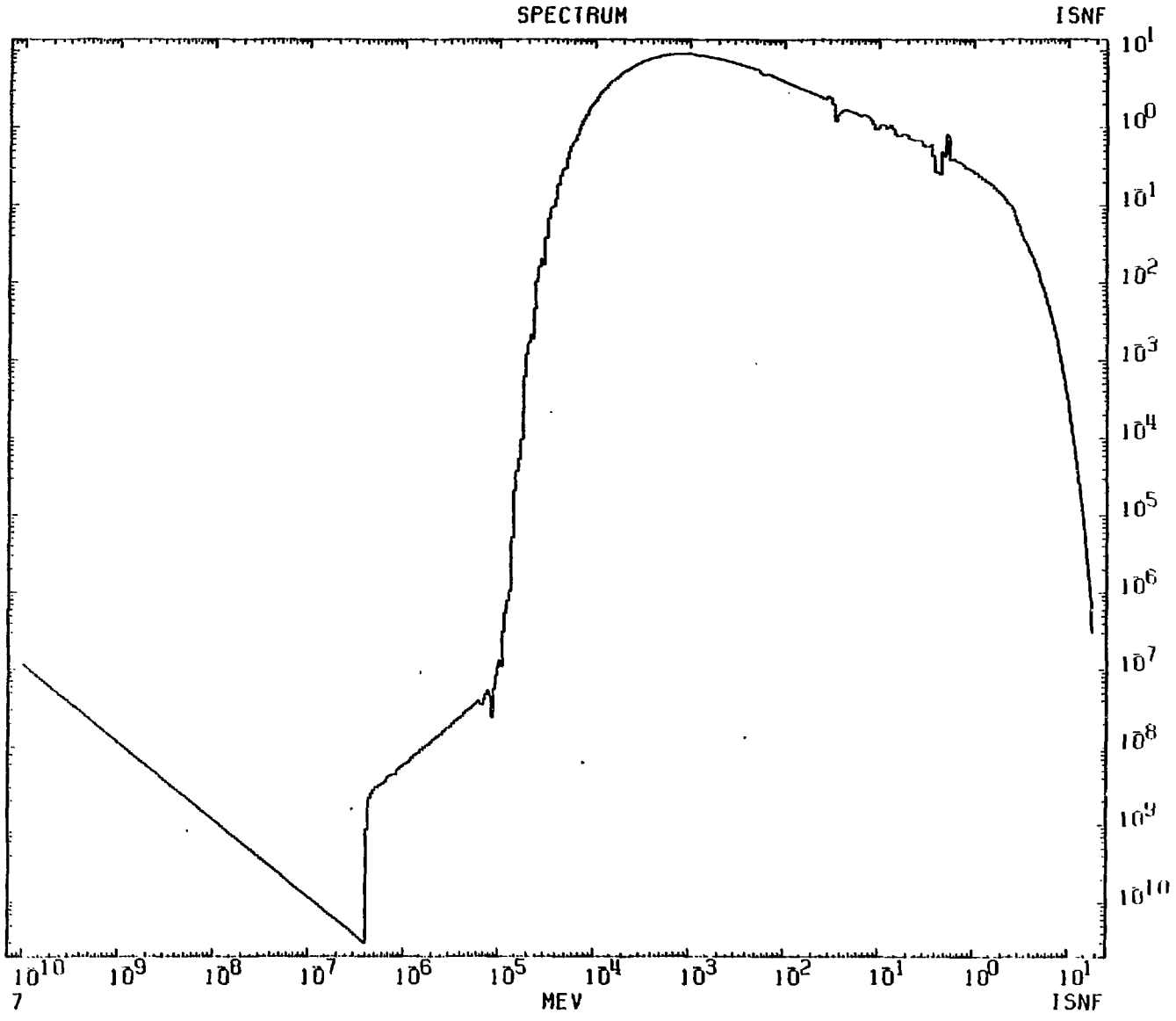

SPECTRUM
NBS CF-252
0.300
0.200
0.100
0
PROBABILITY PER MEV
10^{10} 10^{9} 10^{8} 10^{7} 10^{6} 10^{5} 10^{4} 10^{3} 10^{2} 10^{1} 10^{0} 10^{1}
2
MEV
NBS CF-252

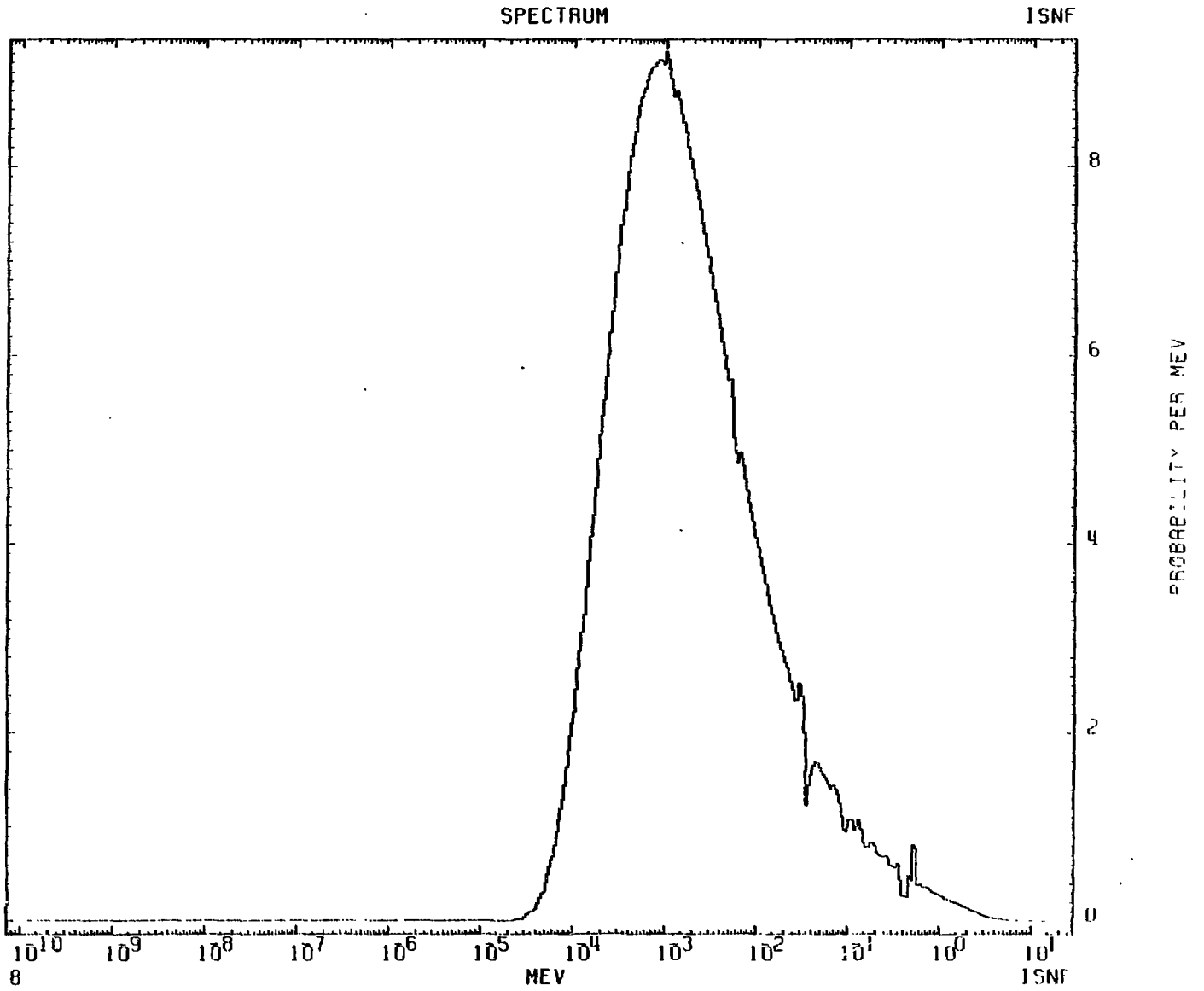

SPECTRUM
NBS U-235
10^{1}
5
10^{2}
5
10^{3}
5
10^{4}
5
10^{5}
5
PROBABILITY PER MEV
10^{10}
10^{9}
10^{8}
10^{7}
10^{6}
10^{5}
10^{4}
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}
MEV
NBS U-235

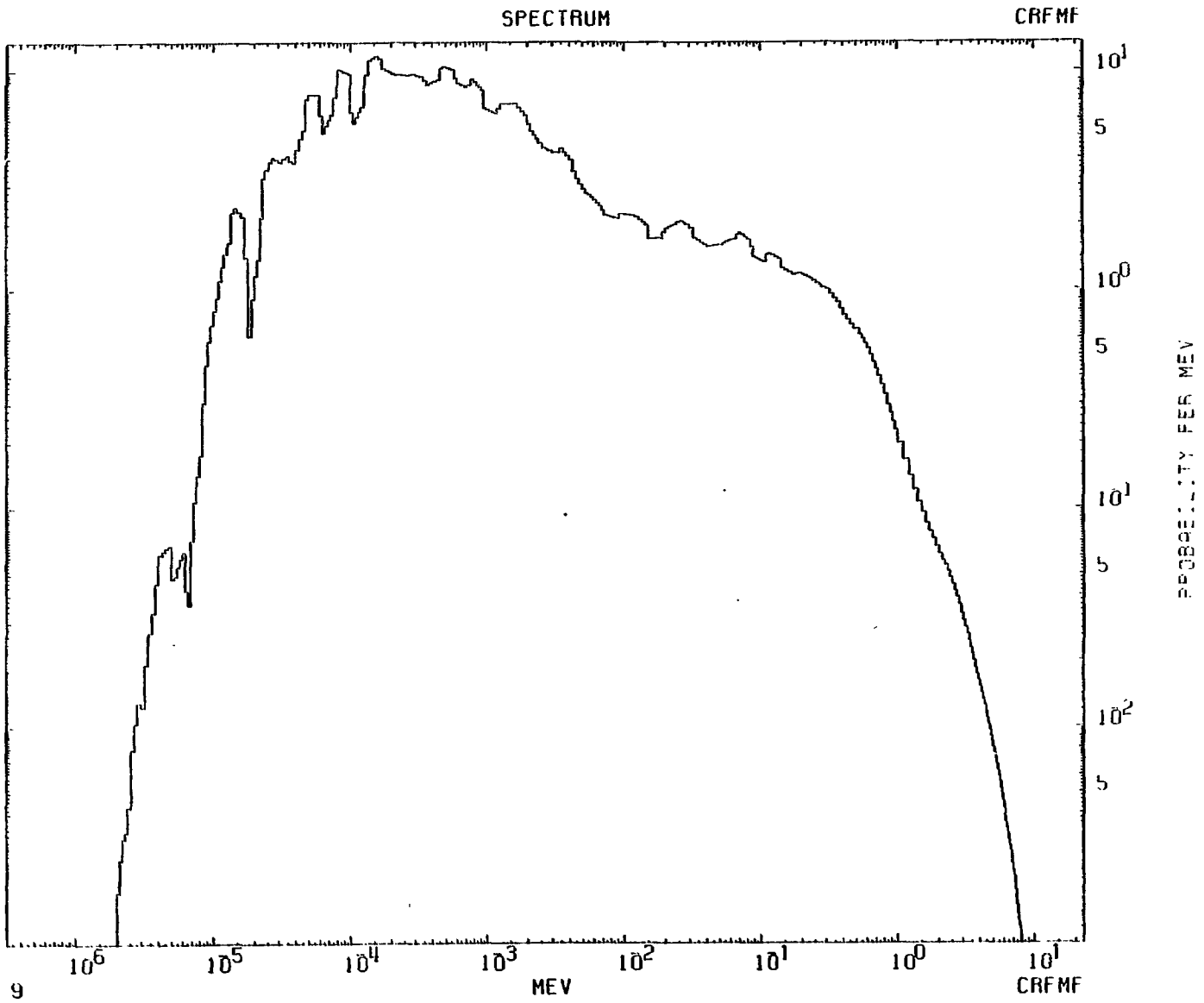

SPECTRUM
NBS U-235
0.300
0.200
0.100
0
PROBABILITY PER MEV
10^{10} 10^{9} 10^{8} 10^{7} 10^{6} 10^{5} 10^{4} 10^{3} 10^{2} 10^{1} 10^{0} 10^{-1}
MEV
NBS U-235

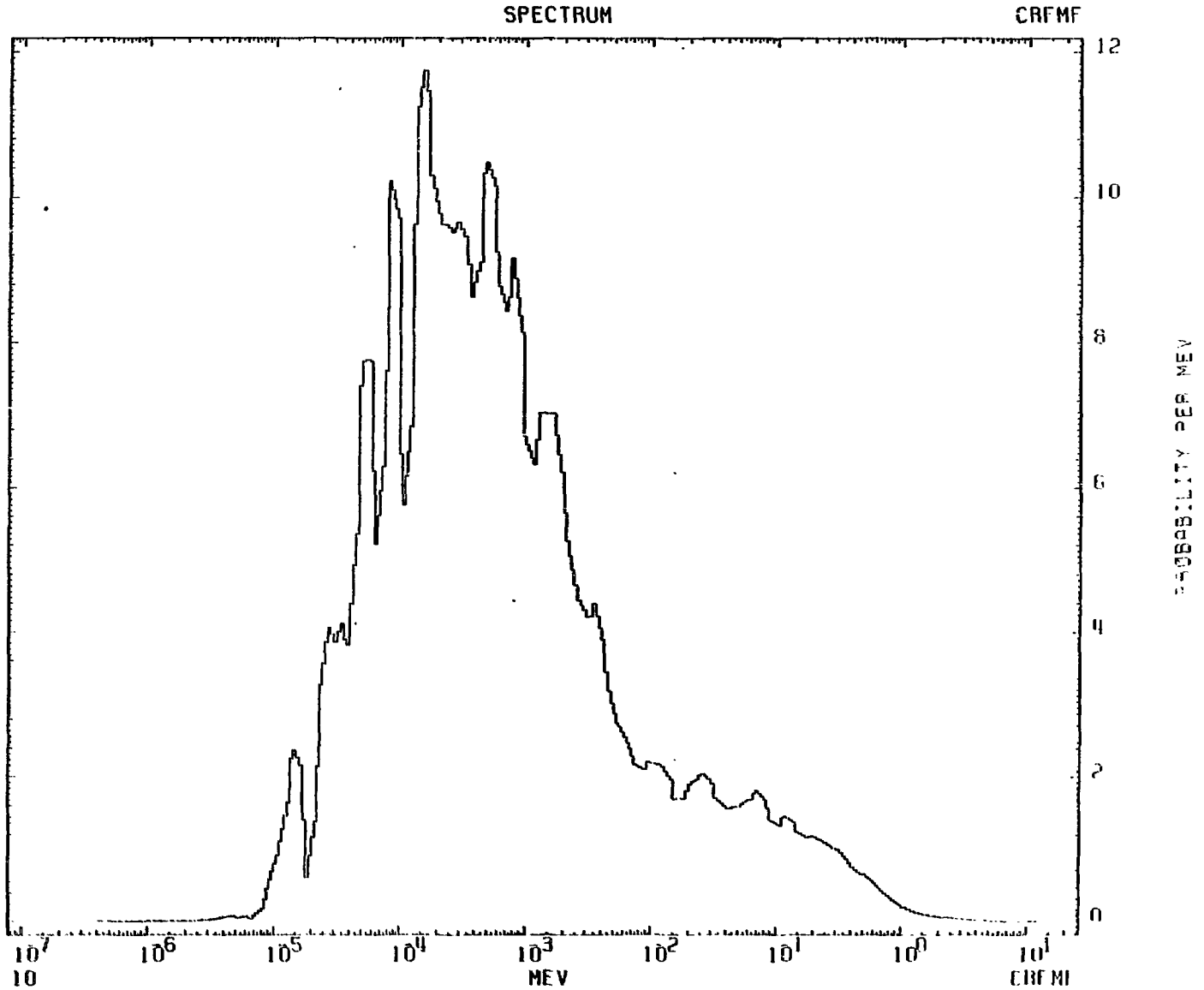

SPECTRUM
ENDF U-235
10^1
5
10^2
5
10^3
5
10^4
5
10^5
5
PROBABILITY PER MEV
10^{10} 10^9 10^8 10^7 10^6 10^5 10^4 10^3 10^2 10^1 10^0 10^{-1}
5
MEV
ENDF U-235

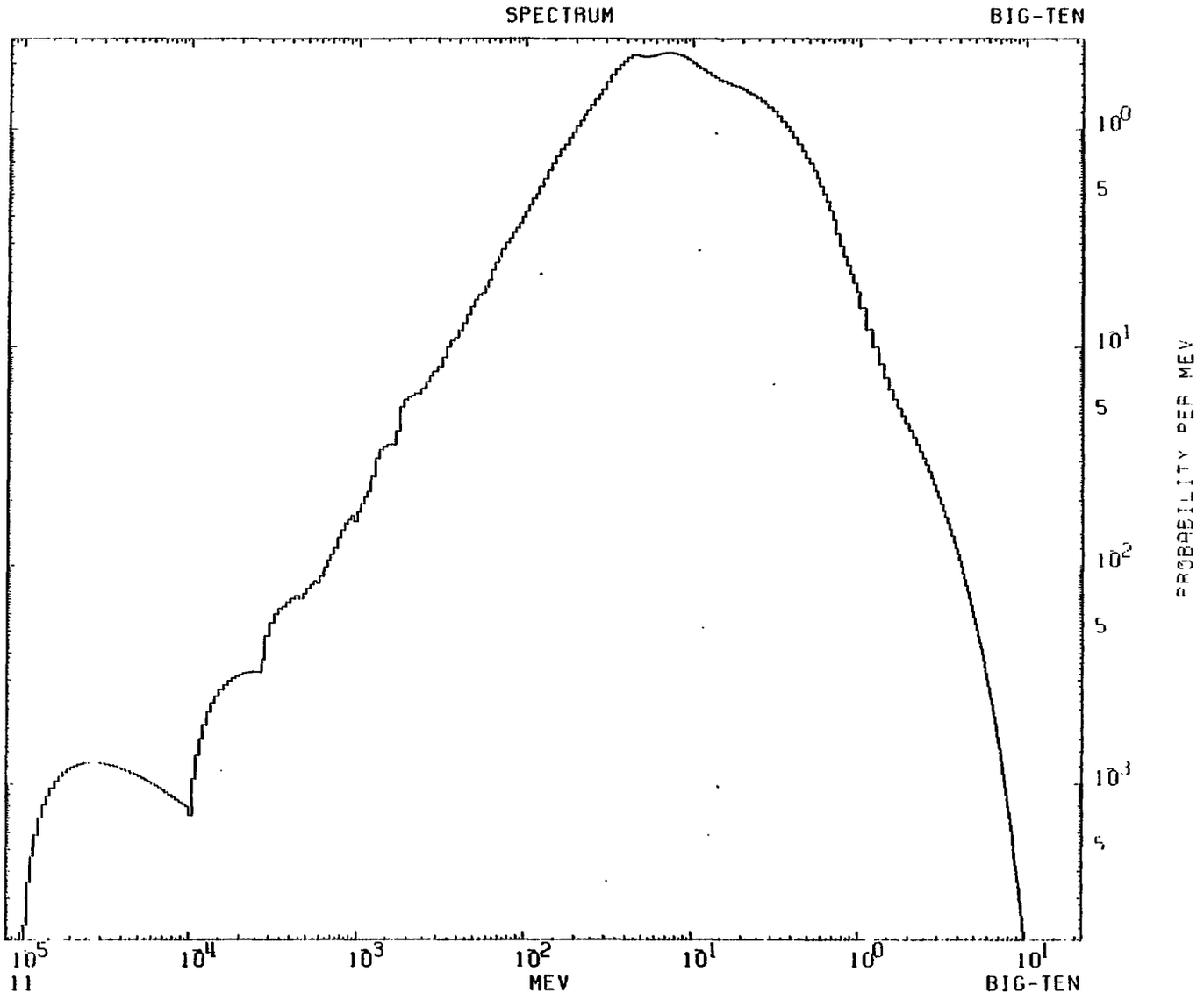

SPECTRUM
ENDF U-235
0.300
0.200
0.100
0
PROBABILITY PER MEV
10^{10} 10^{9} 10^{8} 10^{7} 10^{6} 10^{5} 10^{4} 10^{3} 10^{2} 10^{1} 10^{0} 10^{1}
MEV
ENDF U-235


SPECTRUM
ISNF
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
10^{-8}
10^{-9}
10^{-10}
PROBABILITY PER MEV
10^{10} 10^{9} 10^{8} 10^{7} 10^{6} 10^{5} 10^{4} 10^{3} 10^{2} 10^{1} 10^{0} 10^{-1}
MEV
ISNF

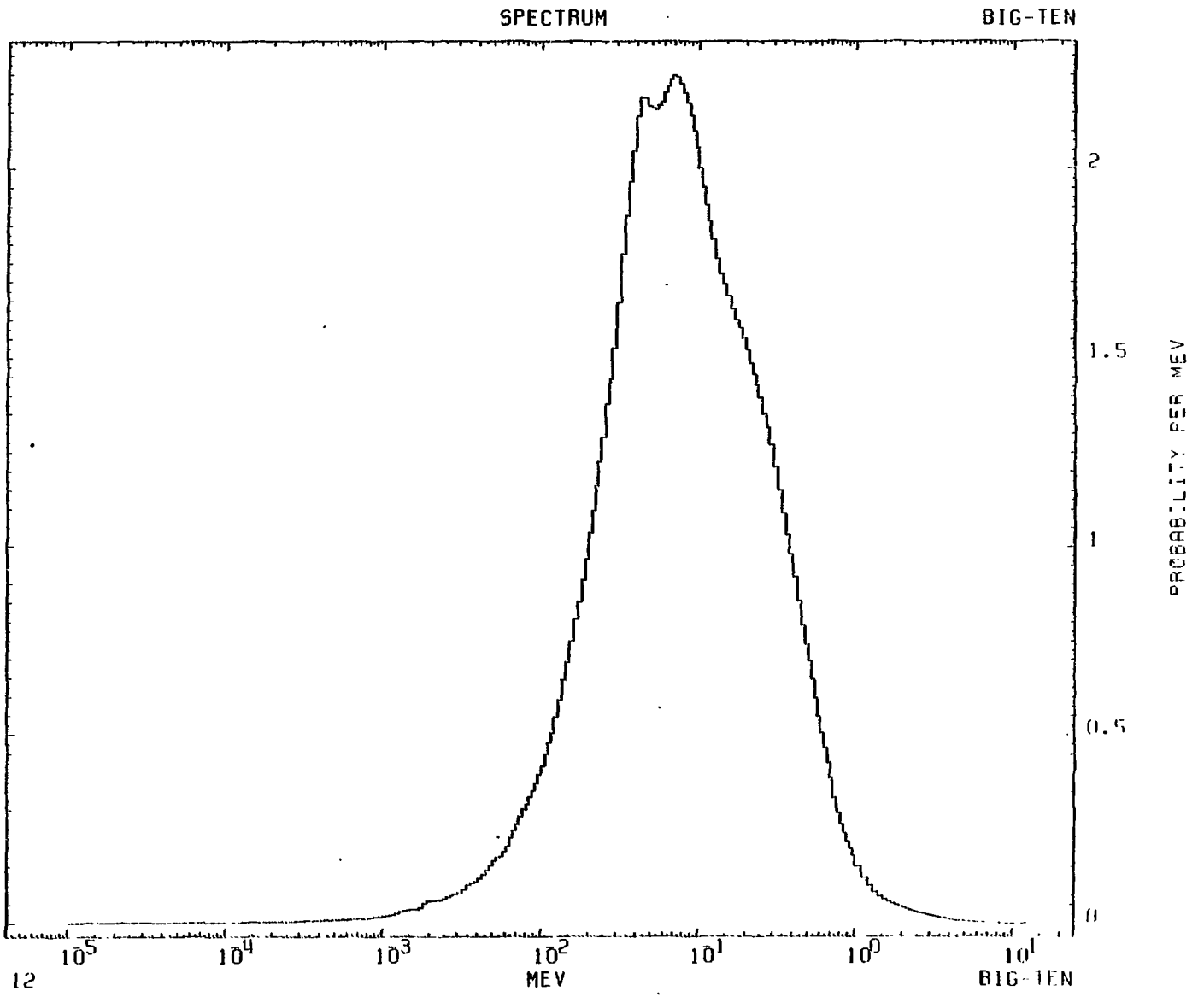

SPECTRUM
ISNF
8
6
4
2
0
PROBABILITY PER MEV
10^{10} 10^{9} 10^{8} 10^{7} 10^{6} 10^{5} 10^{4} 10^{3} 10^{2} 10^{1} 10^{0} 10^{1}
8
MEV
ISNF

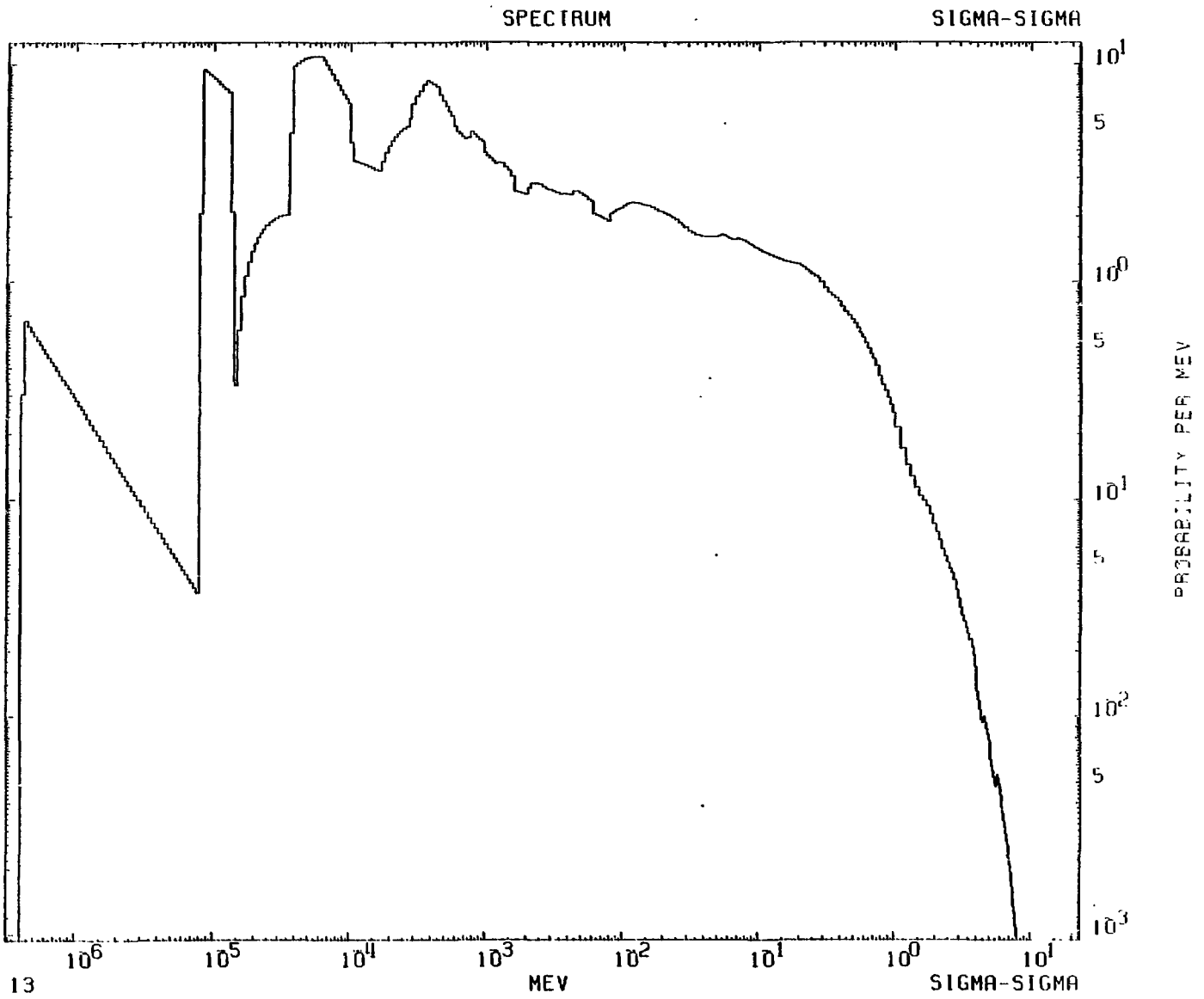

SPECTRUM
CRFMF
10^1
5
10^0
5
10^{-1}
5
10^{-2}
5
PROBABILITY PER MEV
10^6
10^5
10^4
10^3
10^2
10^1
10^0
10^{-1}
MEV
CRFMF

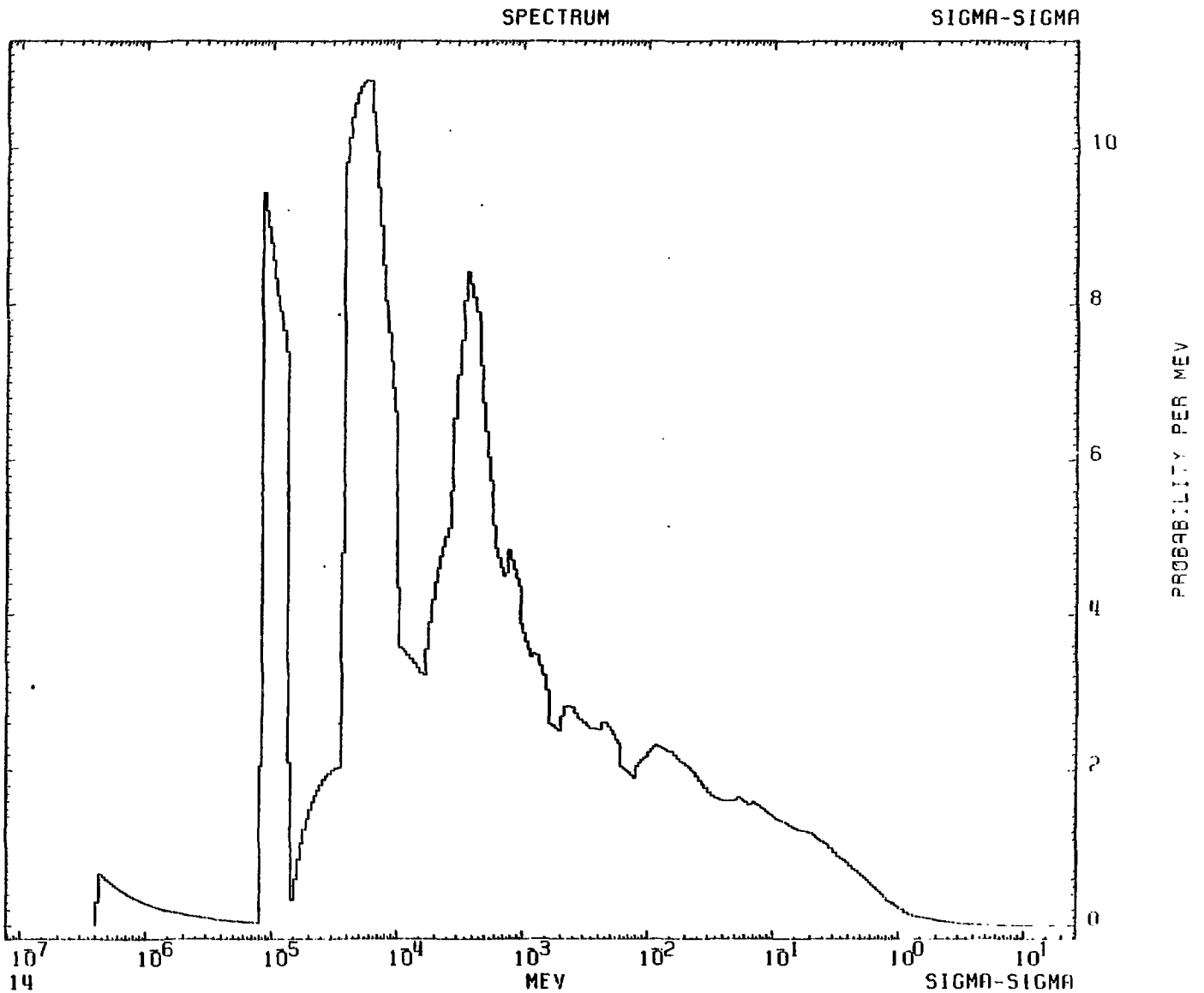

SPECTRUM
CRFMF
12
10
8
6
4
2
0
PROBABILITY PER MEV
10^{7}
10
10^{6}
10^{5}
10^{4}
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}
MEV
CRFMI

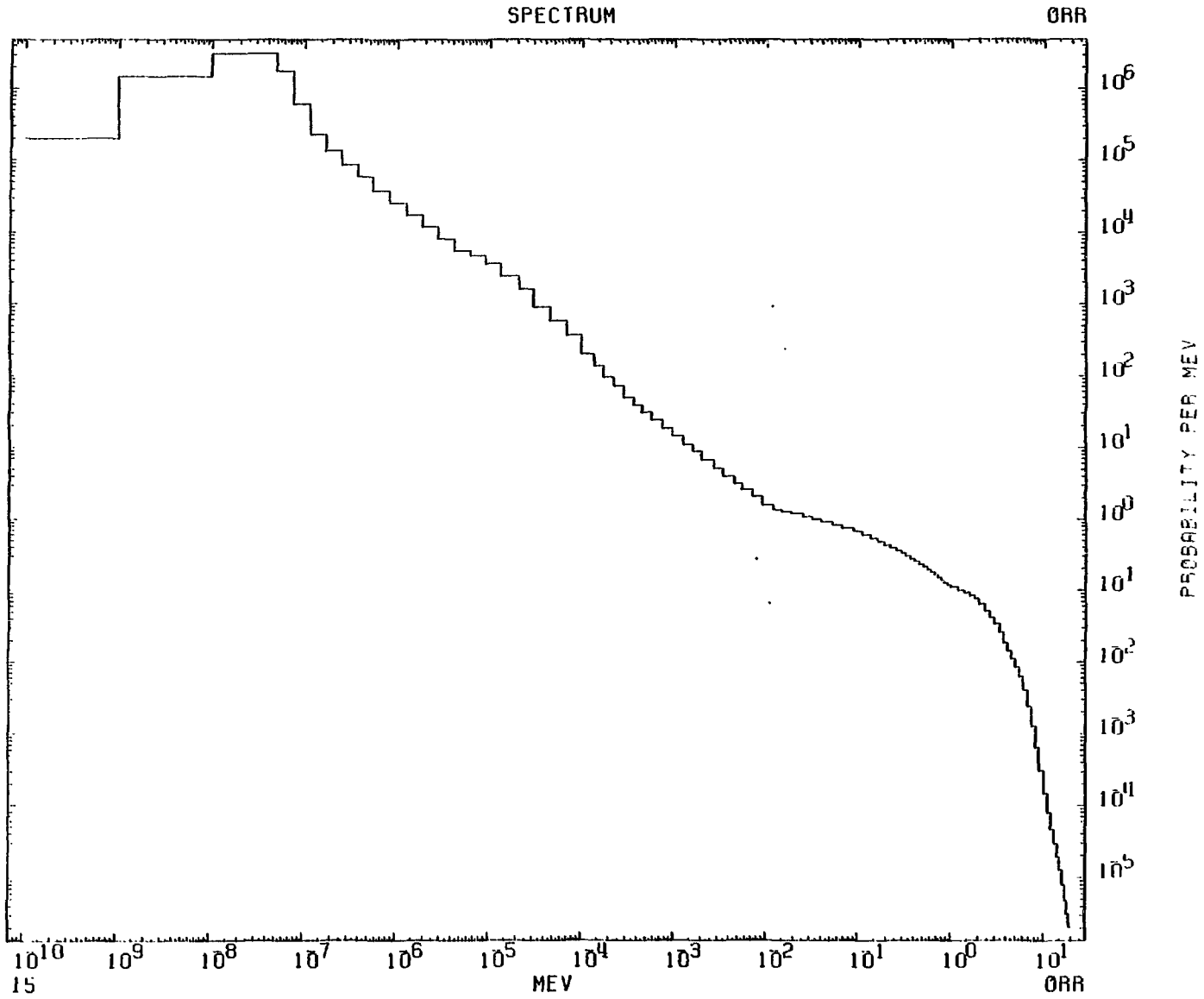

SPECTRUM
BIG-TEN
10^0
5
10^1
5
10^2
5
10^3
5
PROBABILITY PER MEV
10^5
10^4
10^3
10^2
10^1
10^0
10^1
11
MEV
BIG-TEN


SPECTRUM
BIG-TEN

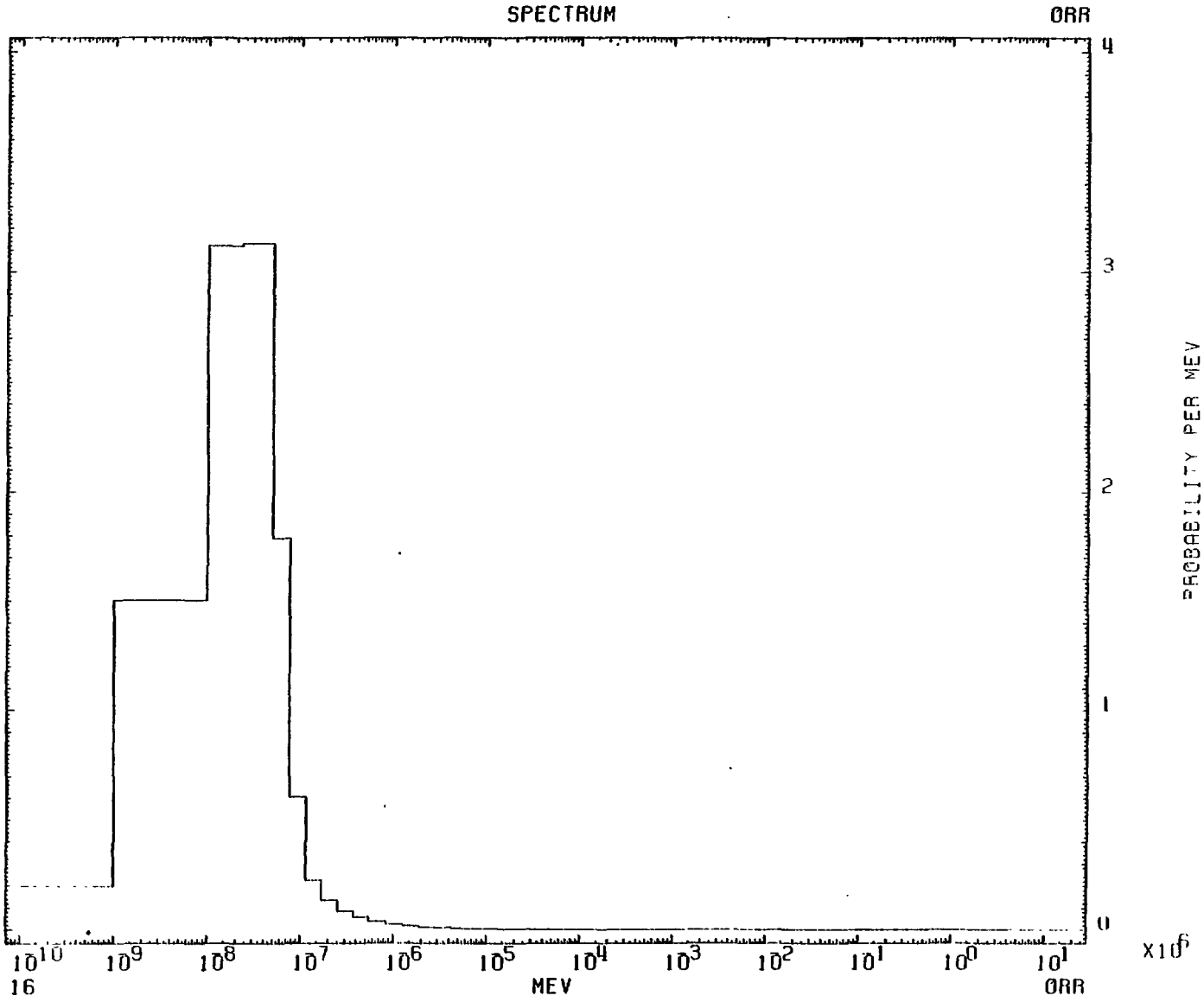

SPECTRUM
BIG-TEN
2
1.5
1
0.5
0
PROBABILITY PER MEV
10^5
10^4
10^3
10^2
10^1
10^0
10^{-1}
MEV
12
BIG-TEN

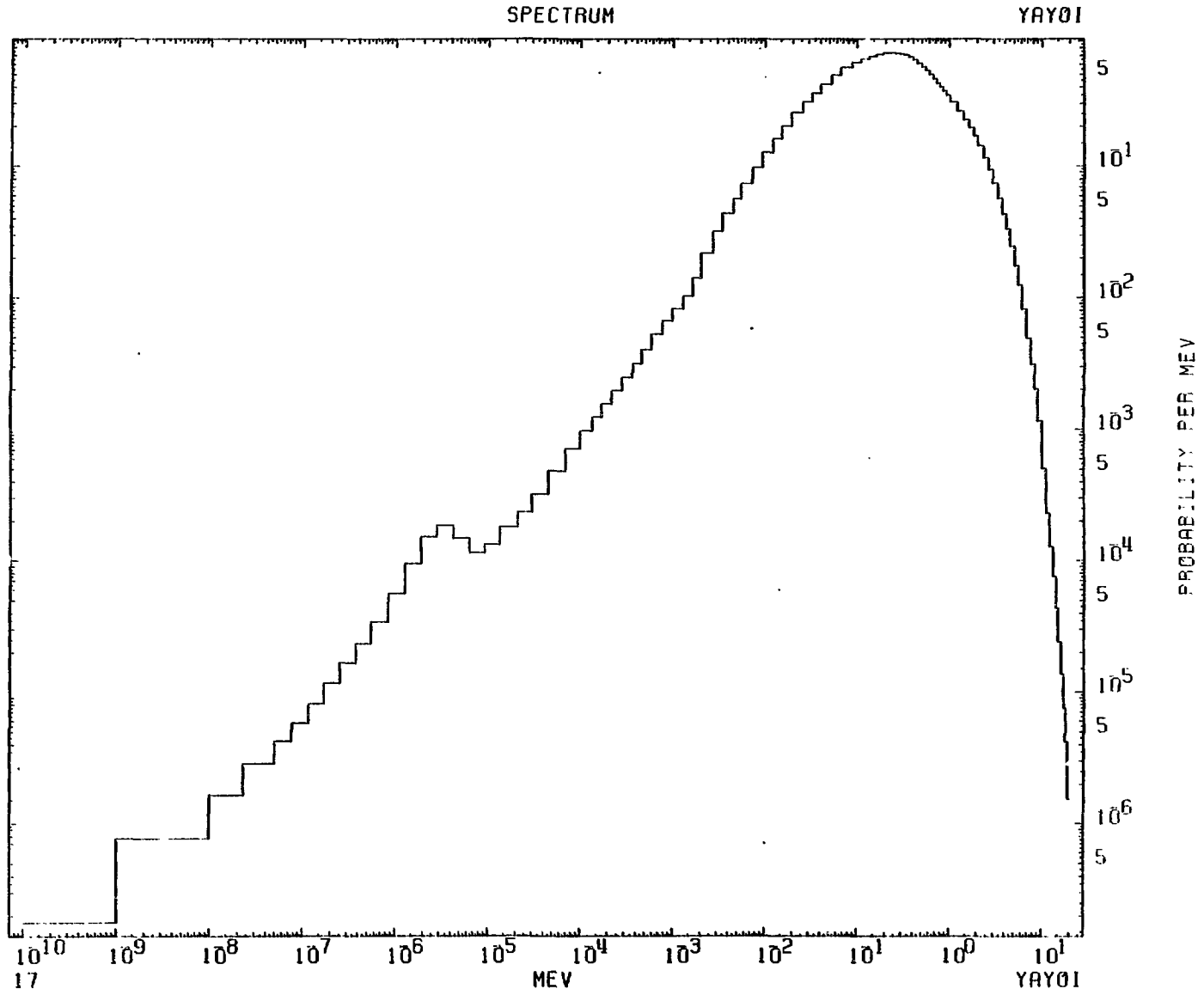

SPECTRUM
SIGMA-SIGMA
10^1
5
10^0
5
10^1
5
10^2
5
10^3
PROBABILITY PER MEV
10^6
10^5
10^4
10^3
10^2
10^1
10^0
10^1
13
MEV
SIGMA-SIGMA

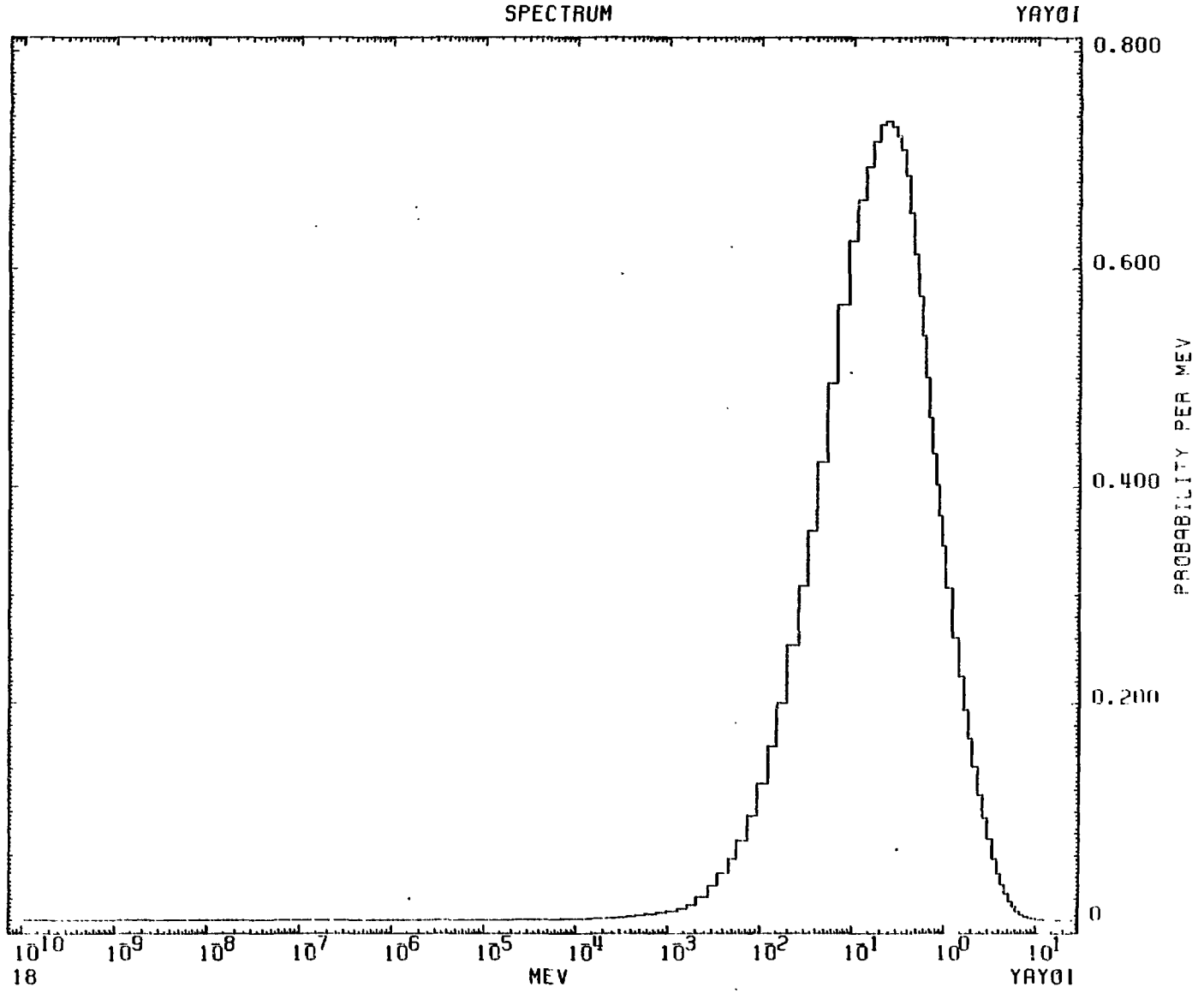

SPECTRUM
SIGMA-SIGMA
10
8
6
4
2
0
PROBABILITY PER MEV
10^{7}
10^{6}
10^{5}
10^{4}
10^{3}
10^{2}
10^{1}
10^{0}
10^{1}
14
MEV
SIGMA-SIGMA

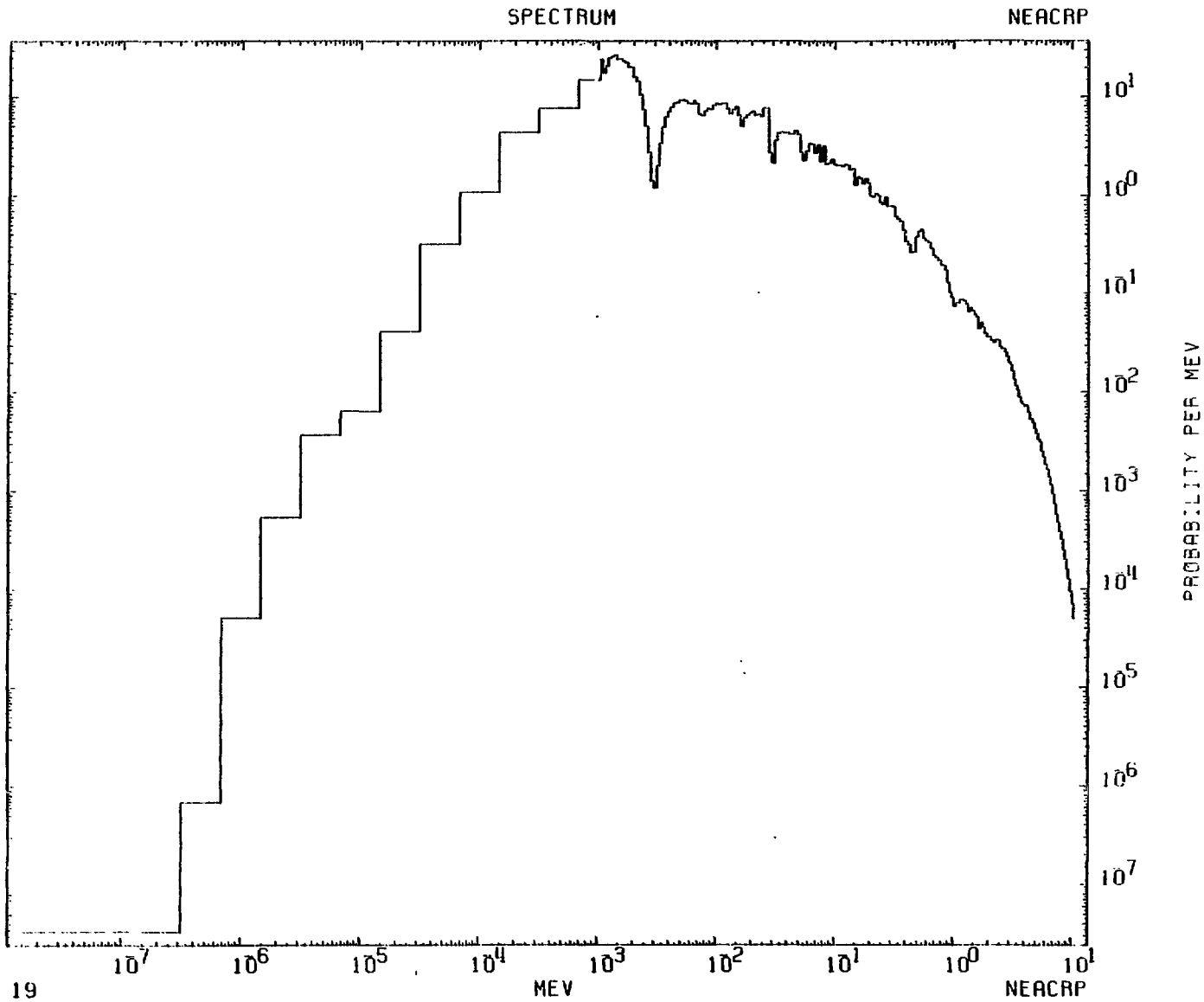


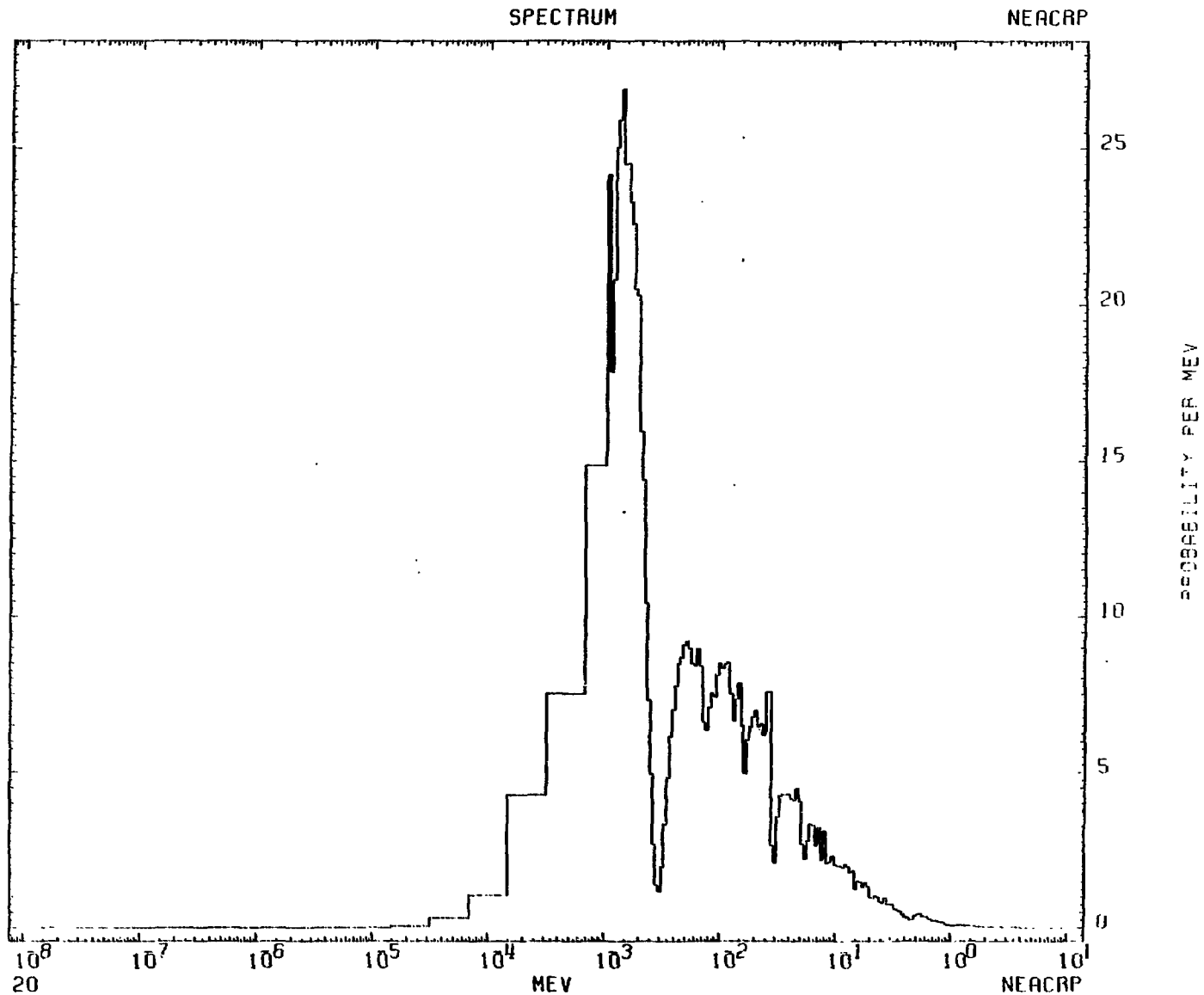
SPECTRUM ORR


SPECTRUM
ORR
4
3
2
1
0
PROBABILITY PER MEV
X10^6
10^10 10^9 10^8 10^7 10^6 10^5 10^4 10^3 10^2 10^1 10^0 10^-1
16
MEV
ORR


SPECTRUM
YAY01
5
10^{1}
5
10^{2}
5
10^{3}
5
10^{4}
5
10^{5}
5
10^{6}
5
PROBABILITY PER MEV
10^{10} 10^{9} 10^{8} 10^{7} 10^{6} 10^{5} 10^{4} 10^{3} 10^{2} 10^{1} 10^{0} 10^{1}
17
MEV
YAY01


SPECTRUM
YAYOI
0.800
0.600
0.400
0.200
0
PROBABILITY PER MEV
10^{10} 10^{9} 10^{8} 10^{7} 10^{6} 10^{5} 10^{4} 10^{3} 10^{2} 10^{1} 10^{0} 10^{1}
18
MEV
YAYOI


SPECTRUM
NEACRP
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
PROBABILITY PER MEV
10^{7}
10^{6}
10^{5}
10^{4}
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}
19
MEV
NEACRP


SPECTRUM
NEACRP
25
20
15
10
5
0
PROBABILITY PER MEV
10^{8}
10^{7}
10^{6}
10^{5}
10^{4}
10^{3}
10^{2}
10^{1}
10^{0}
10^{1}
20
MEV
NEACRP