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The
International Reactor Dosimetry File
(IRDF-85)

Assembled
by
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and
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Abstract

This document describes the contents of the second version of the International Reactor Dosimetry File (IRDF-85), distributed by the Nuclear Data Section of the International Atomic Energy Agency. This library superceded IRDF-82.

April 1985

Revised by P.K.McLaughlin IAEA/NDS Jan. 2005

The file was revised to conform with ENDF/B format standards.. The merged file was corrected for format errors and processed through the code CHECKR to ensure, as far as possible, format compatibility.

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I. Introduction

The 1985 version of the International Reactor Dosimetry File (IRDF-85) 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. The multigroup structure is the SAND-II group structure which normally his 620 groups extending up to 18 MeV. This structure has been extended to 640 groups by adding 20 groups each 100 KeV wide between 18 and 20 MeV.

II. Dosimetry Cross Sections

The IRDF-85 Dosimetry cross section library contains the following data,

(1.) The entire ENDF/B-V Dosimetry Library (Mod. 2) as distributed by Brookhaven National Laboratory [2]. These data were converted to 640 group form at the Nuclear Data Section.

(2.) The entire ENDF/B-V gas production file as distributed by Brookhaven National Laboratory. These data were converted to 640 groups form at the Nuclear Data Section.

(3.) 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 640 group form [6] at the Nuclear Data Section.

(4.) 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 640 group format [6] at the Nuclear Data Section.

(5.) 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 640 group form [6] at the Nuclear Data Section.

(6.) ASTM and EUR standards displacement cross sections for Iron and ASTM standard damage cross sections for Iron, Nickel and Chromium as provided by Zijp [10] in the form of 640 group cross sections. This data was converted to the ENDF/B-V format at the Nuclear Data Section.

(7.) 58Ni and 59Ni cross section provided by F. Mann through W. Zijp [10]. These data were converted to 640 group form at the Nuclear Data Section. With the exception of the ^{241}Am(n, f) ^{58}Ni, ^{59}Ni, and the displacement cross sections, all reactions have accompanying uncertainty information. All of these data are presented in the standard ENDF/B-V format [1]. However, since ENDF/B-V does not have an MT [2] number corresponding to displacement 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 displacement
= 801- EUR iron displacement.

See section V for a complete list of materials with dosimetry cross sections in the IRDF-85 library and section VI for a complete list of reactions in IRDF-85. Spectra average cross sections are presented in section VII, comparison to 252Cf and 235U experimentally measured spectra averages are presented in section VIII and plots of all cross sections in section IX.

III. Benchmark Spectra

The IRDF-85 Benchmark Spectra library contains ten benchmark spectra including ,

(1.) The NBS 252Cf spontaneous fission; the NBS 235U and ENDF/B-V 235U 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=l 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).

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

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[5] PRONYAEV, V., and SCHWERER, 0., 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, Pet ten (1985).

[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. IRDF-85
Cross Sections
Table of Contents
By Material

Z E1 A	MAT NO.	SPECIFICATION	LAB	DATE	AUTHOR	REFERENCE	ENDF TAP NO.
3-Li- 6g	5303	Neutron cross sections only	LASL	DEC78	L.STEWART, G.HALE, P.YOUNG		
3-Li- 6g	6424	Neutron + error files	LASL	DEC78	L.STEWART, G.HALE, P.YOUNG		
3-Li- 7g	5397	Neutron + error files	LANL	DEC81	P.G.YOUNG		
4-Be- 9g	5304	Neutron cross sections only	LLL	OCT76	HOWERTON, PERKINS		
5-B - 10g	5305	Neutron cross sections only	LASL	JAN79	L.STEWART, G.HALE, P.YOUNG		
5-B - 10g	6425	Neutron + error files	LASL	JAN79	L.STEWART, G.HALE, P.YOUNG		
5-B - 11g	5160	Neutron cross sections only	GE-BNL	SEP71	C.COWAN		
6-C - 0g	5306	Neutron cross sections only	ORNL	NOV79	C. Y. FU		
7-N - 14g	5275	Neutron cross sections only	LASL	JUL73	P.YOUNG, D.FOSTER, JR., G.HALE	LA-4725 (1972)	
9-F - 19g	920	Neutron + error files	3AUSIRK	79	S.TAGESEN,H.VONACH,B.STROHMAIER	FIN.REP.ON RC,80	
9-F - 19g	5309	Neutron cross sections only	ORNL	DEC80	LARSON,HETRICK,AND FU		
11-Na- 23g	1120	Neutron + error files	3POLIBJ	FEB79	ADAMSKI, HERMAN AND MARCINKOWSKI	.INR-1809,9,79	
11-Na- 23g	6311	Neutron (RP) + error files	ORNL	DEC77	D.C.LARSON		
12-Mg- 24g	1220	Neutron + error files	3AUSIRK	79	S.TAGESEN,H.VONACH,B.STROHMAIER	B,PH-DAT,13-1,79	
13-Al- 27g	5313	Neutron cross sections only	LASL	DEC73	P.G. YOUNG, D.G. FOSTER, JR.	LA-4726 (1973).	
13-Al- 27g	6313	Neutron + error files	LASL	DEC73	P.G. YOUNG, D.G. FOSTER, JR.	LA-4726 (1973).	
14-Si- 0g	5314	Neutron cross sections only	ORNL	MAY80	D.C.LARSON AND D.M.HETRICK		
15-P - 31g	1520	Neutron + error files	3AUSIRK	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- 0g	5322	Neutron cross sections only	BURANLLLL	AUG77	C.PHILIS,A.SMITH,R.HOWERTON	ANL/NDM-28,1977	
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.		
23-V - 0g	5323	Neutron cross sections only	ANLLLLHEDL	JAN77	A.SMITH+,H.HOWERTON,F.MANN.	ANL/NDM-24,1977	
24-Cr- 0g	5324	Neutron cross sections only	BNL	DEC77	A.PRINCE AND T.W.BURROWS		
24-Cr- 0g	8002	Neutron cross sections only	PETTEN	85	W.J.ZIJP	RIVATE COMM.	
25-Mn- 55g	5325	Neutron cross sections only	BNL	MAR77	S.F. MUGHABGHAB		
25-Mn- 55g	6325	Neutron + error files	BNL	MAR77	S.F. MUGHABGHAB		
26-Fe- 0g	5326	Neutron cross sections only	ORNL	NOV79	C. Y. FU		
26-Fe- 0g	8000	Neutron cross sections only	PETTEN	79	W.L.ZIJP	PRIVATE COM.	
26-Fe- 0g	8001	Neutron cross sections only	PETTEN	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	5327	Neutron cross sections only	BNL	JUN77	S.MUGHABGHAB		
27-Co- 59g	6327	Neutron (RP) + error files	BNL	JUN77	S.MUGHABGHAB		
28-Ni- 0g	5328	Neutron cross sections only	BNL(NNDC)	MAR77	M.DIVADEENAM		
28-Ni- 0g	8003	Neutron cross sections only	PETTEN	85	W.J.ZIJP	RIVATE COMM.	
28-Ni- 58g	6433	Neutron + error files	BNL	MAR77	M.DIVADEENAM		
28-Ni- 58g	7288	Neutron cross sections only	BNL	MAY78	DIVADEENAM		
28-Ni- 59g	2859	Neutron cross sections only	HEDL		F.M.MANN		
28-Ni- 60g	6434	Neutron + error files	BNL	MAR77	M.DIVADEENAM		
29-Cu- 0g	5329	Neutron cross sections only	ORNL	NOV79	C. Y. FU		
29-Cu- 63g	2920	Neutron + error files	3AUSIRK	79	S.TAGESEN,H.VONACH,B.STROHMAIER	B,PH-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	3AUSIRK	79	S.TAGESEN,H.VONACH,B.STROHMAIER	B,PH-DAT,13-1,79	
40-Zr- 90g	4020	Neutron + error files	3AUSIRK	79	S.TAGESEN,H.VONACH,B.STROHMAIER	B,PH-DAT,13-1,79	
41-Nb- 93g	4120	Neutron + error files	3AUSIRK	79	S.TAGESEN,H.VONACH,B.STROHMAIER	FIN.REP.ON RC,80	
45-Rh-103g	4520	Neutron + error files	3AUSIRK	79	S.TAGESEN,H.VONACH,B.STROHMAIER	FIN.REP.ON RC,80	
49-In-115g	6437	Neutron (RP) + error files Mult.for prod. of radio.nucs.	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	BHAT,SMITH,LEONARD,DESAUSSUREETAL		
92-U -235g	6395	Neutron (RP) + error files	BNL	APR77	M.R.BHAT		
92-U -238g	6398	Neutron (RP) + error files	ANL+	JUN77	E.PENNINGTON,A.SMITH,W.POENITZ	ANL/NDM-32	
93-Np-237g	6337	Neutron (RP) + error files	HEDL,SRL,+	APR78	MANN,BENJAMIN,SMITH,STEIN,REICH,+	HEDL TME 77-54	

Z El A	MAT NO.	SPECIFICATION	LAB	DATE	AUTHOR	REFERENCE	ENDF TAP NO.
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	7	J.E.LYNN,B.H.PATRICK,M.G.SOWERBY+		

VI. IRDF-85
Cross Sections
Table of Contents
By Reaction

3-Li- 6g	Mat.No: 5303 Date: DEC78 Ref:	Lab: LASL Author: L.STEWART, G.HALE, P.YOUNG Card images: 662		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		Total hydrogen production	-2.72730+ 6
			Total deuterium production	-1.50000+ 6
			Total tritium production	4.78380+ 6
			Total 4He production	4.78380+ 6
3-Li- 6g	Mat.No: 6424 Date: DEC78 Ref:	Lab: LASL Author: L.STEWART, G.HALE, P.YOUNG Card images: 346		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		Total 4He production	4.78380+ 6
	Data covariance matrices for neutron X-sections		Total 4He production	4.78380+ 6
3-Li- 7g	Mat.No: 5397 Date: DEC81 Ref:	Lab: LANL Author: P.G.YOUNG Card images: 479		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		Total hydrogen production	-1.09490+ 7
			Total deuterium production	-7.75320+ 6
			Total tritium production	-2.46670+ 6
			Total 4He production	-2.46670+ 6
	Data covariance matrices for neutron X-sections		Total hydrogen production	-1.09490+ 7
			Total deuterium production	-7.75320+ 6
			Total tritium production	-2.46670+ 6
			Total 4He production	-2.46670+ 6

4-Be- 9g	Mat.No: 5304 Date: OCT76 Ref:	Lab: LLL Author: HOWERTON, PERKINS Card images: 261		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		Total hydrogen production Total deuterium production Total tritium production Total 4He production	-1.28300+ 7 -1.46600+ 7 -1.04400+ 7 -6.00000+ 5
5-B - 10g	Mat.No: 5305 Date: JAN79 Ref:	Lab: LASL Author: L.STEWART, G.HALE, P.YOUNG Card images: 604		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		Total hydrogen production Total deuterium production Total 4He production	2.26700+ 5 -4.36100+ 6 2.79000+ 6
5-B - 10g	Mat.No: 6425 Date: JAN79 Ref:	Lab: LASL Author: L.STEWART, G.HALE, P.YOUNG Card images: 342		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		Total 4He production	2.79000+ 6
	Data covariance matrices for neutron X-sections		Total 4He production	2.79000+ 6

5-B - 11g	Mat.No: 5160 Date: SEP71 Ref:	Lab: GE-BNL Author: C.COWAN Card images: 131	
	File Type	Reaction Type	Q-Value
	General Information	Descriptive data and Dictionary	
	Resonance parameter data	Resonance information	
	Neutron cross sections	Total hydrogen production Total tritium production Total 4He production	-1.07200+ 7 -9.52700+ 6 -6.59600+ 6
6-C - 0g	Mat.No: 5306 Date: NOV79 Ref:	Lab: ORNL Author: C. Y. FU Card images: 99	
	File Type	Reaction Type	Q-Value
	General Information	Descriptive data and Dictionary	
	Resonance parameter data	Resonance information	
	Neutron cross sections	Total hydrogen production Total 4He production	-1.25880+ 7 -5.69500+ 6
7-N - 14g	Mat.No: 5275 Date: JUL73 Ref: LA-4725 (1972)	Lab: LASL Author: P.YOUNG, D.FOSTER, JR., G.HALE Card images: 384	
	File Type	Reaction Type	Q-Value
	General Information	Descriptive data and Dictionary	
	Resonance parameter data	Resonance information	
	Neutron cross sections	Total hydrogen production Total 4He production	6.26400+ 5 -1.57300+ 5
9-F - 19g	Mat.No: 920 Date: 79 Ref: FIN.REP.ON RC,80	Lab: 3AUSIRK Author: S.TAGESEN,H.VONACH,B.STROHMAIER Card images: 123	
	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

9-F - 19g	Mat.No: 5309 Date: DEC80 Ref:	Lab: ORNL Author: LARSON,HETRICK,AND FU Card images: 155		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		Total hydrogen production Total 4He production	-4.03600+ 6 -1.52300+ 6
11-Na- 23g	Mat.No: 1120 Date: FEB79 Ref: ,INR-1809,9,79	Lab: 3POLIBJ Author: ADAMSKI, HERMAN AND MARCINKOWSKI Card images: 99		
	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: 388		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		(n,g) radiative capture cross section	6.96150+ 6
	Data covariance matrices for resonance parameters		Resonance information	
	Data covariance matrices for neutron X-sections		(n,g) radiative capture cross section	6.96150+ 6
12-Mg- 24g	Mat.No: 1220 Date: 79 Ref: B,PH-DAT,13-1,79	Lab: 3AUSIRK Author: S.TAGESEN,H.VONACH,B.STROHMAIER Card images: 298		
	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: 5313 Date: DEC73 Ref: LA-4726 (1973).	Lab: LASL Author: P.G. YOUNG, D.G. FOSTER, JR. Card images: 243		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		Total hydrogen production Total 4He production	-1.82780+ 6 -3.13160+ 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: 239		
	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,a) cross section	-1.82780+ 6 -3.13160+ 6
	Data covariance matrices for neutron X-sections		(n,p) cross section (n,a) cross section	-1.82780+ 6 -3.13160+ 6
14-Si- 0g	Mat.No: 5314 Date: MAY80 Ref:	Lab: ORNL Author: D.C.LARSON AND D.M.HETRICK Card images: 188		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		Total hydrogen production Total 4He production	-2.89900+ 6 -3.30000+ 4

15-P - 31g	Mat.No: 1520 Date: 79 Ref: FIN.REP.ON RC,80	Lab: 3AUSIRK Author: S.TAGESEN,H.VONACH,B.STROHMAIER Card images: 221	
	File Type	Reaction Type	Q-Value
	General Information	Descriptive data and Dictionary	
	Neutron cross sections	(n,p) cross section	-7.07000+ 5
	Data covariance matrices for neutron X-sections	(n,p) cross section	-7.07000+ 5
16-S - 32g	Mat.No: 6439 Date: APR79 Ref:	Lab: BNL Author: DIVADEENAM Card images: 135	
	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+ 5
	Data covariance matrices for neutron X-sections	(n,p) cross section	-9.27500+ 5
21-Sc- 45g	Mat.No: 6426 Date: JUL79 Ref:	Lab: BNL Author: MAGURNO AND MUGHABGHAB Card images: 492	
	File Type	Reaction Type	Q-Value
	General Information	Descriptive data and Dictionary	
	Resonance parameter data	Resonance information	
	Neutron cross sections	(n,g) radiative capture cross section	
	Data covariance matrices for neutron X-sections	(n,g) radiative capture cross section	
22-Ti- 0g	Mat.No: 5322 Date: AUG77 Ref: ANL/NDM-28,1977	Lab: BURANLLLL Author: C.PHILIS,A.SMITH,R.HOWERTON Card images: 321	
	File Type	Reaction Type	Q-Value
	General Information	Descriptive data and Dictionary	
	Resonance parameter data	Resonance information	
	Neutron cross sections	Total hydrogen production Total 4He production	

22-Ti- 46g	Mat.No: 6427 Date: JAN77 Ref:	Lab: ANL Author: C.PHILIS,O.BERSILLON,D.SMITH,ETC. Card images: 118	
	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,O.BERSILLON,D.SMITH,ETC Card images: 176	
	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+ 5
	Data covariance matrices for neutron X-sections	(n,n'p) cross section (n,p) cross section	-1.04600+ 7 3.18710+ 5
22-Ti- 48g	Mat.No: 6429 Date: JAN77 Ref:	Lab: ANL Author: C.PHILIS,O.BERSILLON,D.SMITH ETC. Card images: 162	
	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

23-V - 0g	Mat.No: 5323 Date: JAN77 Ref: ANL/NDM-24,1977	Lab: ANLLLLHEDL Author: A.SMITH+,H.HOWERTON,F.MANN. Card images: 460		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		Total hydrogen production Total 4He production	3.00000+ 6 7.59000+ 5
24-Cr- 0g	Mat.No: 5324 Date: DEC77 Ref:	Lab: BNL Author: A.PRINCE AND T.W.BURROWS Card images: 318		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		Total hydrogen production Total deuterium production Total tritium production Total 3He production Total 4He production	-2.56600+ 5 -7.36420+ 6 -9.96500+ 6 -8.62810+ 6 1.79400+ 6
24-Cr- 0g	Mat.No: 8002 Date: 85 Ref: RIVATE COMM.	Lab: PETTEN Author: W.J.ZIJP Card images: 137		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Neutron cross sections		Damage (ASTM)	
25-Mn- 55g	Mat.No: 5325 Date: MAR77 Ref:	Lab: BNL Author: S.F. MUGHABGHAB Card images: 176		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		Total hydrogen production Total 4He production	-1.80980+ 6 -6.21600+ 5

25-Mn- 55g	Mat.No: 6325 Date: MAR77 Ref:	Lab: BNL Author: S.F. MUGHABGHAB Card images: 89	
	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: 5326 Date: NOV79 Ref:	Lab: ORNL Author: C. Y. FU Card images: 159	
	File Type	Reaction Type	Q-Value
	General Information	Descriptive data and Dictionary	
	Resonance parameter data	Resonance information	
	Neutron cross sections	Total hydrogen production Total 4He production	8.90000+ 4 8.48400+ 5
26-Fe- 0g	Mat.No: 8000 Date: 79 Ref: PRIVATE COM.	Lab: PETTEN Author: W.L.ZIJP Card images: 239	
	File Type	Reaction Type	Q-Value
	General Information	Descriptive data and Dictionary	
	Neutron cross sections	Damage (ASTM)	
26-Fe- 0g	Mat.No: 8001 Date: 79 Ref: PRIVATE COM.	Lab: PETTEN Author: W.L.ZIJP Card images: 239	
	File Type	Reaction Type	Q-Value
	General Information	Descriptive data and Dictionary	
	Neutron cross sections	Damage (EUR)	

26-Fe- 54g	Mat.No: 6430 Date: JUN79 Ref:	Lab: HEDL Author: R.SCHENTER F.SCHMITTROTH F.MANN Card images: 147	
	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: 6431 Date: JUL78 Ref:	Lab: ORNL Author: C.Y.FU Card images: 154	
	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: 372	
	File Type	Reaction Type	Q-Value
	General Information	Descriptive data and Dictionary	
	Resonance parameter data	Resonance information	
	Neutron cross sections	(n,g) radiative capture cross section	6.58660+ 6
	Data covariance matrices for resonance parameters	Resonance information	
	Data covariance matrices for neutron X-sections	(n,g) radiative capture cross section	6.58660+ 6

27-Co- 59g	Mat.No: 5327 Date: JUN77 Ref:		Lab: BNL Author: S.MUGHABGHAB Card images: 191	
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		Total hydrogen production Total 4He production	-7.83000+ 5 3.17800+ 5
27-Co- 59g	Mat.No: 6327 Date: JUN77 Ref:		Lab: BNL Author: S.MUGHABGHAB Card images: 634	
	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 (n,g) radiative capture cross section (n,a) cross section	-1.04610+ 7 7.49000+ 6 3.17800+ 5
	Data covariance matrices for neutron X-sections		direct (n,2n) cross section (n,g) radiative capture cross section (n,a) cross section	-1.04610+ 7 7.49000+ 6 3.17800+ 5
28-Ni- 0g	Mat.No: 5328 Date: MAR77 Ref:		Lab: BNL(NNDC) Author: M.DIVADEENAM Card images: 429	
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		Total hydrogen production Total deuterium production Total 4He production	3.94700+ 5 -5.95260+ 6 3.57490+ 6

28-Ni- 0g	Mat.No: 8003 Date: 85 Ref: RIVATE COMM.	Lab: PETTEN Author: W.J.ZIJP Card images: 137		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Neutron cross sections		Damage (ASTM)	
28-Ni- 58g	Mat.No: 6433 Date: MAR77 Ref:	Lab: BNL Author: M.DIVADEENAM Card images: 221		
	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 (n,p) cross section	-1.22030+ 7 3.94700+ 5
	Data covariance matrices for neutron X-sections		direct (n,2n) cross section (n,p) cross section	-1.22030+ 7 3.94700+ 5
28-Ni- 58g	Mat.No: 7288 Date: MAY78 Ref:	Lab: BNL Author: DIVADEENAM Card images: 307		
	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 (n,g) radiative capture cross section	-1.22030+ 7
28-Ni- 59g	Mat.No: 2859 Date: Ref:	Lab: HEDL Author: F.M.MANN Card images: 683		
	File Type		Reaction Type	Q-Value
	General Information		Descriptive data and Dictionary	
	Resonance parameter data		Resonance information	
	Neutron cross sections		(n,g) radiative capture cross section (n,p) cross section (n,a) cross section	

28-Ni- 60g	Mat.No: 6434 Date: MAR77 Ref:	Lab: BNL Author: M.DIVADEENAM Card images: 120	
	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- 0g	Mat.No: 5329 Date: NOV79 Ref:	Lab: ORNL Author: C. Y. FU Card images: 461	
	File Type	Reaction Type	Q-Value
	General Information	Descriptive data and Dictionary	
	Resonance parameter data	Resonance information	
	Neutron cross sections	Total hydrogen production Total 4He production	1.69300+ 4
29-Cu- 63g	Mat.No: 2920 Date: 79 Ref: B,PH-DAT,13-1,79	Lab: 3AUSIRK Author: S.TAGESEN,H.VONACH,B.STROHMAIER Card images: 178	
	File Type	Reaction Type	Q-Value
	General Information	Descriptive data and Dictionary	
	Neutron cross sections	direct (n,2n) cross section	-1.08500+ 7
	Data covariance matrices for neutron X-sections	direct (n,2n) cross section	-1.08500+ 7

29-Cu- 63g	Mat.No: 6435 Date: JUL78 Ref:	Lab: ORNL Author: C.Y.FU Card images: 548	
	File Type	Reaction Type	Q-Value
	General Information	Descriptive data and Dictionary	
	Resonance parameter data	Resonance information	
	Neutron cross sections	(n,g) radiative capture cross section (n,a) cross section	7.91590+ 6 1.71490+ 6
	Data covariance matrices for resonance parameters	Resonance information	
	Data covariance matrices for neutron X-sections	(n,g) radiative capture cross section (n,a) cross section	7.91590+ 6 1.71490+ 6
29-Cu- 65g	Mat.No: 6436 Date: JUL78 Ref:	Lab: ORNL Author: C.Y.FU Card images: 125	
	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: B,PH-DAT,13-1,79	Lab: 3AUSIRK Author: S.TAGESEN,H.VONACH,B.STROHMAIER Card images: 276	
	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: 182	
	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: 268	
	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: 233	
	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: 560	
	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,g) radiative capture cross section	-3.36000+ 5 6.59800+ 6
	Multiplicities for prod. of radioactive nucs.	(n,g) radiative capture cross section	6.59800+ 6
	Data covariance matrices for neutron X-sections	3.36000+ 5 Ev (n,n') Level (n,g) radiative capture cross section	-3.36000+ 5 6.59800+ 6
53-I -127g	Mat.No: 6438 Date: AUG72 Ref:	Lab: STANFORD Author: R.SHER Card images: 91	
	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: 586	
	File Type	Reaction Type	Q-Value
	General Information	Descriptive data and Dictionary	
	Resonance parameter data	Resonance information	
	Neutron cross sections	(n,g) radiative capture cross section	6.51270+ 6
	Data covariance matrices for neutron X-sections	(n,g) radiative capture cross section	6.51270+ 6

90-Th-232g	Mat.No: 6390 Date: DEC77 Ref:	Lab: BNL Author: BHAT,SMITH,LEONARD,DESAUSSUREETAL Card images: 1116		
	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,g) radiative capture cross section	1.88470+ 8 4.78640+ 6
	Data covariance matrices for neutron X-sections		Total fission cross section(sum of MT=19to21,38) (n,g) radiative capture cross section	1.88470+ 8 4.78640+ 6
92-U -235g	Mat.No: 6395 Date: APR77 Ref:	Lab: BNL Author: M.R.BHAT Card images: 1367		
	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)	1.93720+ 8
	Data covariance matrices for neutron X-sections		Total fission cross section(sum of MT=19to21,38)	1.93720+ 8
92-U -238g	Mat.No: 6398 Date: JUN77 Ref: ANL/NDM-32	Lab: ANL+ Author: E.PENNINGTON,A.SMITH,W.POENITZ Card images: 1260		
	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,g) radiative capture cross section	1.98060+ 8 4.80440+ 6
	Data covariance matrices for neutron X-sections		Total fission cross section(sum of MT=19to21,38) (n,g) radiative capture cross section	1.98060+ 8 4.80440+ 6

93-Np-237g	Mat.No: 6337 Date: APR78 Ref: HEDL TME 77-54	Lab: HEDL,SRL,+ Author: MANN,BENJAMIN,SMITH,STEIN,REICH,+ Card images: 1349	
	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)	1.96370+ 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)	1.96370+ 8
94-Pu-239g	Mat.No: 6399 Date: OCT76 Ref:	Lab: GE-FBRD Author: E.KUJAWSKI,L.STEWART(LASL) Card images: 973	
	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)	1.99920+ 8
	Data covariance matrices for neutron X-sections	Total fission cross section(sum of MT=19to21,38)	1.99920+ 8

95-Am-241g	Mat.No: 1009 Date: 7 Ref:	Lab: AERE Author: J.E.LYNN,B.H.PATRICK,M.G.SOWERBY+ Card images: 246	
	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)	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

SPECTRUM		CF-252 FISS (NBS)	U-235 FISS (NBS)	U-235 FISS (ENDF/B-V)	IRNF (NBS)	CFRMF (IDAHO)
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 AVERAGES (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	4.8886- 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	6.6359- 6	6.4621- 6	1.8171- 6	2.0708- 6
11-NA- 23	1120	51	1.290+ 7	(N,2N)	6.4838- 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)	2.1575- 3	1.4535- 3	1.5073- 3	4.0756- 4	3.6636- 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)	3.0637- 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	6426	620	1.000- 4	(N,GAMMA)	5.2595- 3	5.6398- 3	5.4471- 3	2.7773- 2	2.4414- 2
22-TI- 46	6427	164	1.600+ 6	(N,P)	1.3469- 2	1.0812- 2	1.1173- 2	3.2432- 3	2.4576- 3
22-TI- 47	6428	74	1.060+ 7	(N,NP)	2.0623- 5	8.4689- 6	8.1654- 6	2.3146- 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,NP)	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	2.7258- 4	2.8170- 4	7.6616- 5	6.8272- 5
25-MN- 55	6325	76	1.040+ 7	(N,2N)	4.4027- 4	2.0164- 4	2.0114- 4	5.5366- 5	5.6360- 5
26-FE- 0	8000	620	1.000- 4	DAMAGE (ASTM)	8.9510+ 2	8.5415+ 2	8.7405+ 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	1.0364- 3	2.8561- 4	2.4420- 4
26-FE- 58	6432	620	1.000- 4	(N,GAMMA)	1.6605- 3	1.7122- 3	1.6874- 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)	2.1616- 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	1.0516- 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	68	1.120+ 7	(N,2N)	1.9282- 4	8.2463- 5	8.0633- 5	2.2596- 5	2.4688- 5
29-CU- 63	6435	620	1.000- 4	(N,GAMMA)	9.6494- 3	1.0076- 2	9.8682- 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	6436	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	3.4662- 2	3.6125- 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	1.060+ 5	(N,N') FIRST LEVEL	7.1216- 1	6.8896- 1	7.0505- 1	3.8757- 1	2.7967- 1
49-IN-115	6437	193	3.200+ 5	(N,N') FIRST LEVEL	1.8192- 1	1.7338- 1	1.7925- 1	8.4013- 2	4.9592- 2
49-IN-115	6437	620	1.000- 4	(N,GAMMA)	1.2124- 1	1.2659- 1	1.2464- 1	2.8909- 1	2.8222- 1
53-I -127	6438	88	9.200+ 6	(N,2N)	2.3108- 3	1.1862- 3	1.2135- 3	3.2605- 4	3.2163- 4
79-AU-197	6379	620	1.000- 4	(N,GAMMA)	7.6324- 2	8.0944- 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	1.8616- 2
90-TH-232	6390	620	1.000- 4	(N,GAMMA)	8.9676- 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	1.5806+ 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)	6.8334- 2	7.2060- 2	7.0251- 2	2.2703- 1	2.3406- 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

		BIG-TEN (LASL)	SIGMA-SIGMA (MOL)	ORR (ARGONNE)	YAYOI (ARGONNE)	NEACRP (KARLSRUHE)
SPECTRUM						
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)		6.0321+ 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	8.8708- 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	2.6781+ 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	6313 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	9.1330+ 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	2.8196+ 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)	2.3065- 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 209 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	1.0987- 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	2.8374- 1

VIII. Comparison to Experimental Measurements

This section presents comparisons between 235Cf and 235U 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:

[11. DEZSOE, !., and CSIKAI, J., Proc. Kiev Conf. on Neutron Phys., (1977) 32.

[2] MANNRART, W., Private Communication, P.T.B., Braunschweig, (1980).

[3] KOBAYASHI, K. , and KIMURA, I. , NEANDC(J)61, (1979) 81.

[41 KOBAYASHI, K., and KIMURA, I., lNEANDC(J)~7, (IQ80) 42-43.

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

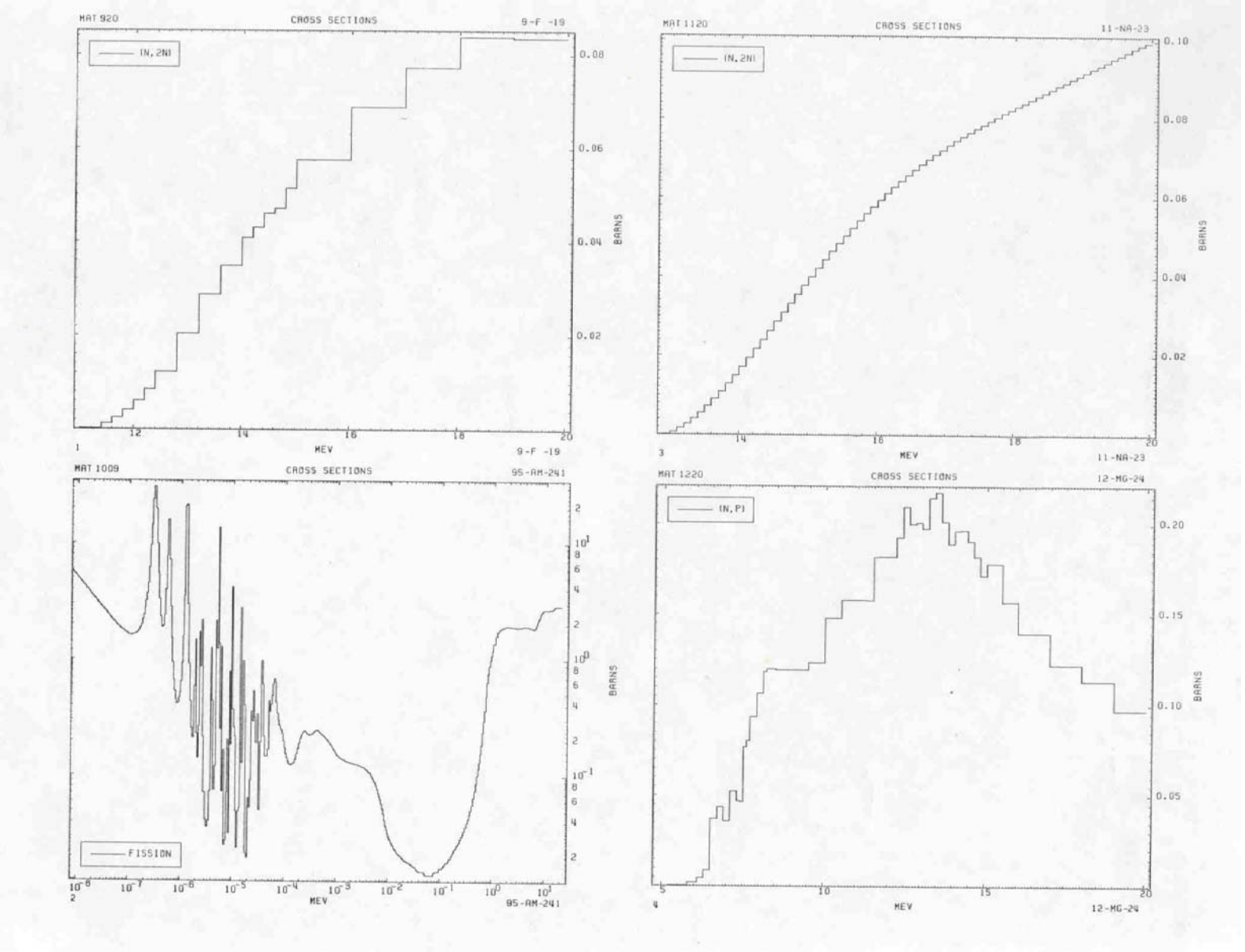
[6] DEZSOE, ~., and CSlKAI, J., Proc. VlIth Symposium on Interactions of Fast Neutrons, Gaussig, (1977).

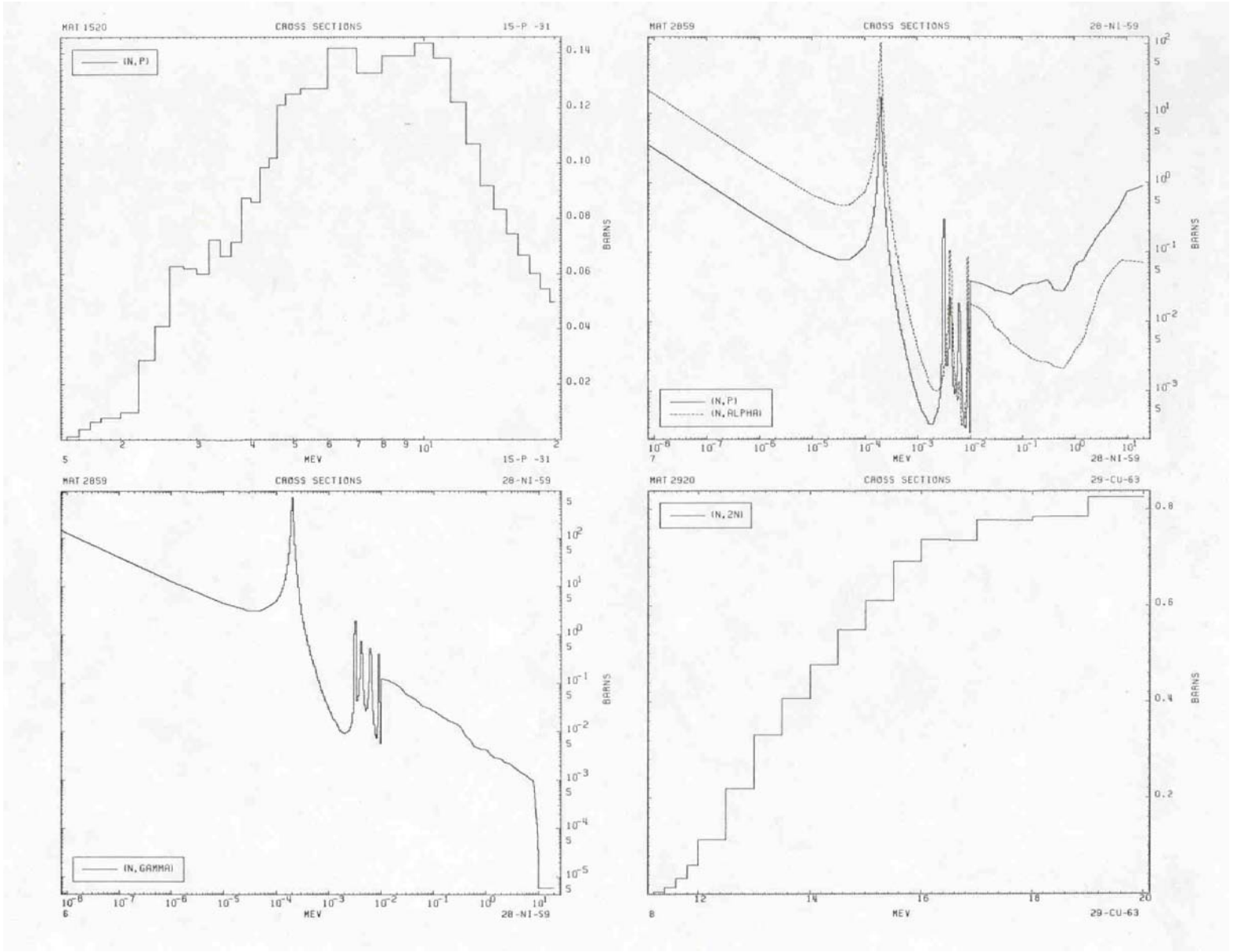
COMPARISON OF EXPERIMENTIALLY MEASURED AND CALCULATED CF-252 AND U-235 FISSION SPECTRA AVERAGES

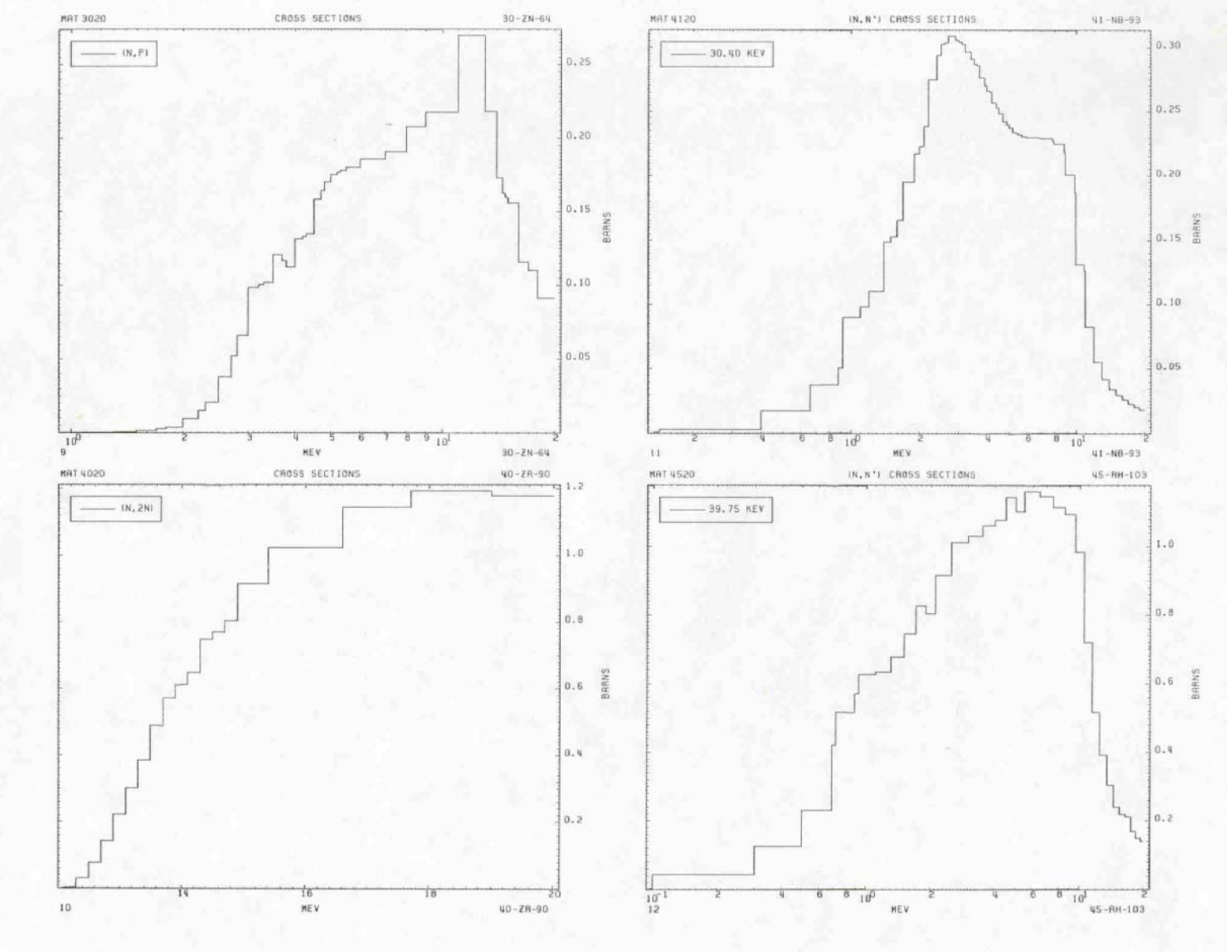
				EXPERIMENTIAL VALUES		EXPERIMENTAL ERROR	COMPARISON TO CALCULATIONS (EVAL-EXP)/EVAL		
				CF-252 FISS	U-235 FISS		CF-252 FISS (NBS)	U-235 FISS (NBS)	U-235 FISS (ENDF/B-V)
ISOTOPE	MAT	GROUPS	THRESHOLD REACTION (EV)	(MILLIBARNS)	(MILLIBARNS)	(PER-CENT)	(PER-CENT)	(PER-CENT)	(PER-CENT)
3-LI- 6	6424	620	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)	6		-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	-25
27-CO- 59	6327	620	1.000- 4 (N,GAMMA)	6.97 (1)		5	-16		
27-CO- 59	6327	125	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)		1.67	-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	163	1.700+ 6 (N,ALPHA)	0.709 (5)		2	+6		
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	88	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						

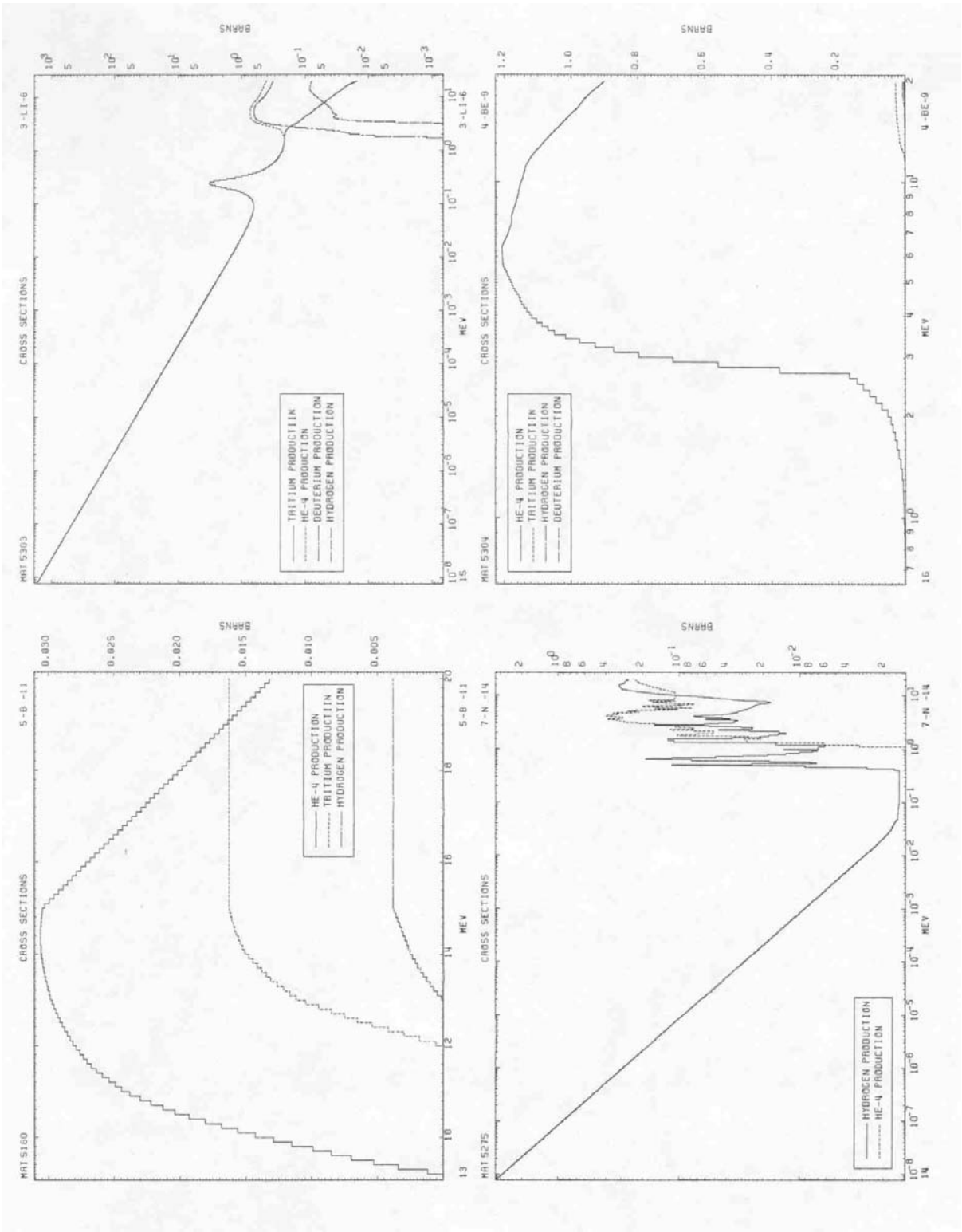
IX. Plots of Cross Sections

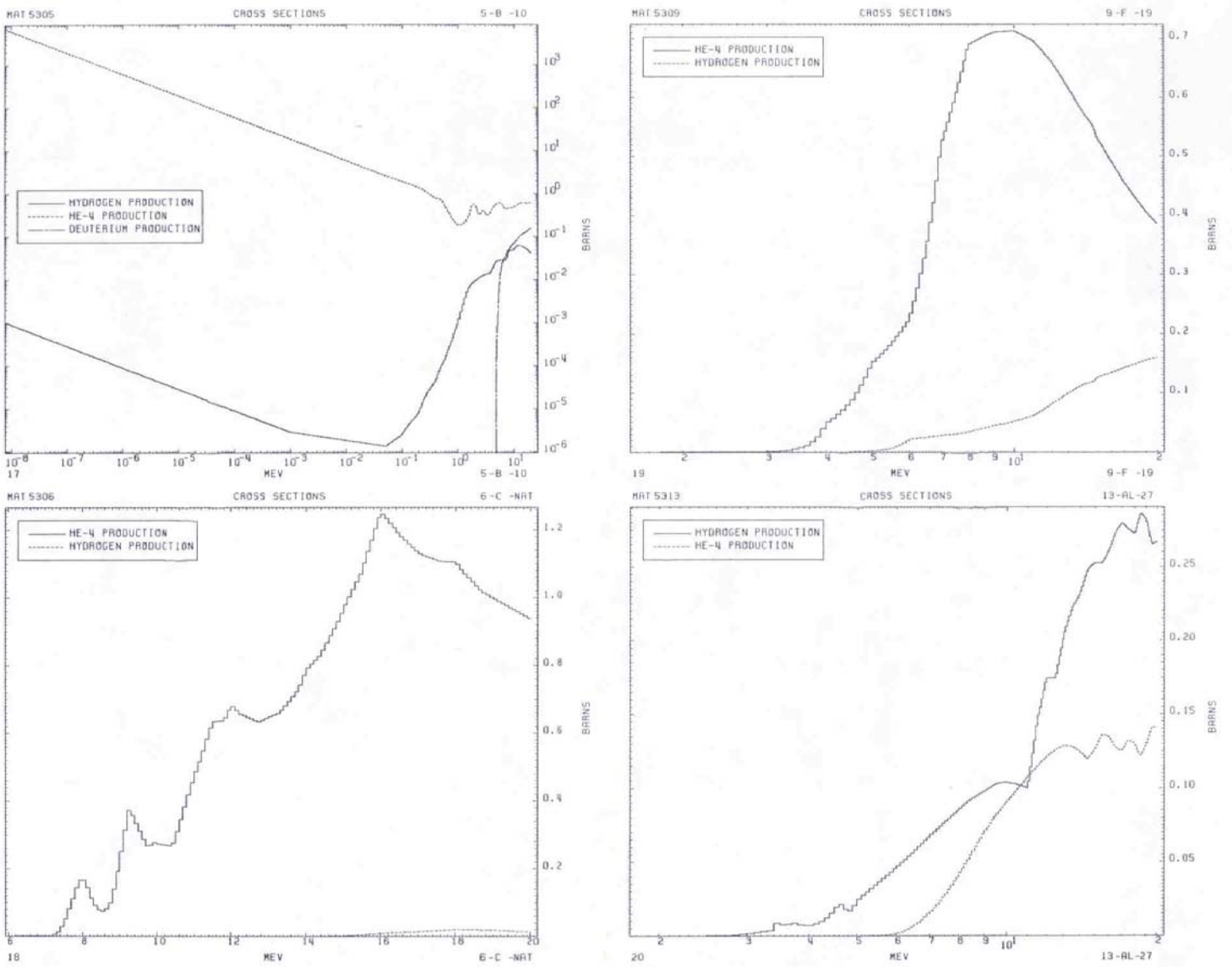
In this section plots are presented in the order in .which they appear in the ENDF/B format; that is they are in MAT number, as opposed to ZA, order. The MAT number assigned to each material may be determined by consulting section V in which there is a ZA ordered list of materials with their associated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

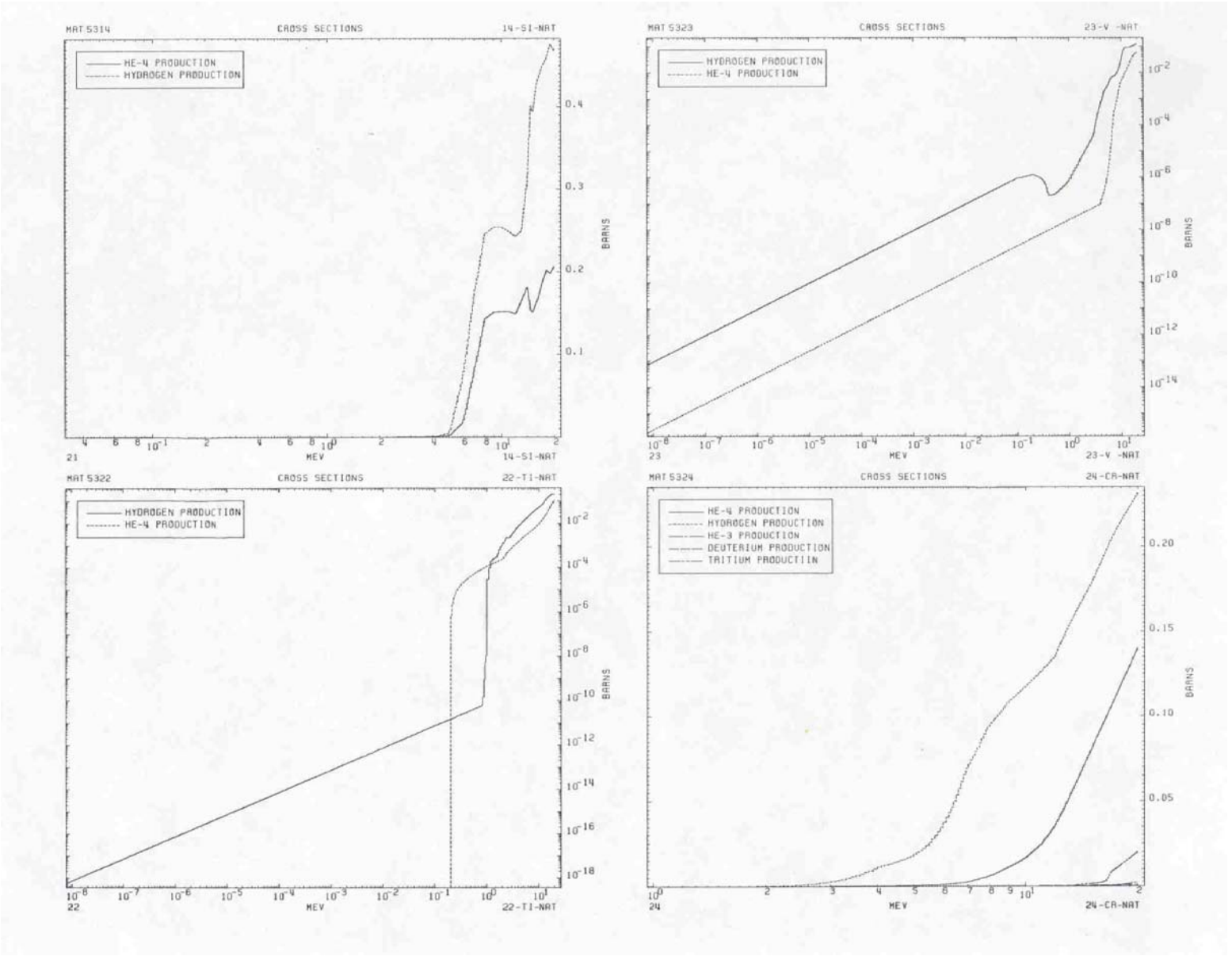

MAT 920
CROSS SECTIONS
9-F -19
(N,2N)
BARNS
MEV
9-F -19
MAT 1120
CROSS SECTIONS
11-NA-23
(N,2N)
BARNS
MEV
11-NA-23
MAT 1009
CROSS SECTIONS
95-AM-241
FISSION
BARNS
MEV
95-AM-241
MAT 1220
CROSS SECTIONS
12-MG-24
(N,P)
BARNS
MEV
12-MG-24

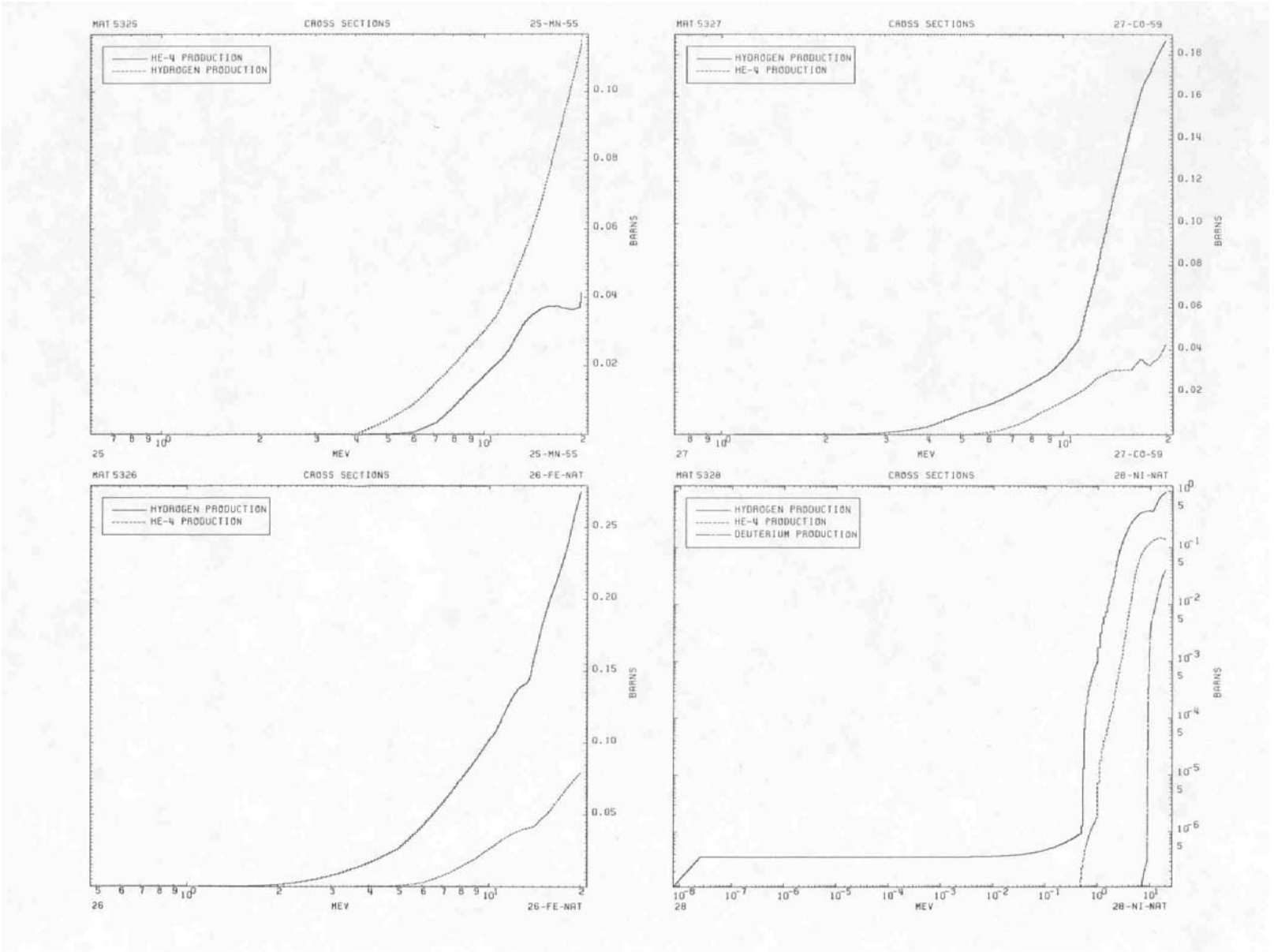

MAT 1520
CROSS SECTIONS
15-P -31
(N,P)
BARNS
MEV
15-P -31
MAT 2859
CROSS SECTIONS
28-NI-59
(N,P)
(N,ALPHA)
BARNS
MEV
28-NI-59
MAT 2859
CROSS SECTIONS
28-NI-59
(N,GAMMA)
BARNS
MEV
28-NI-59
MAT 2920
CROSS SECTIONS
29-CU-63
(N,2N)
BARNS
MEV
29-CU-63

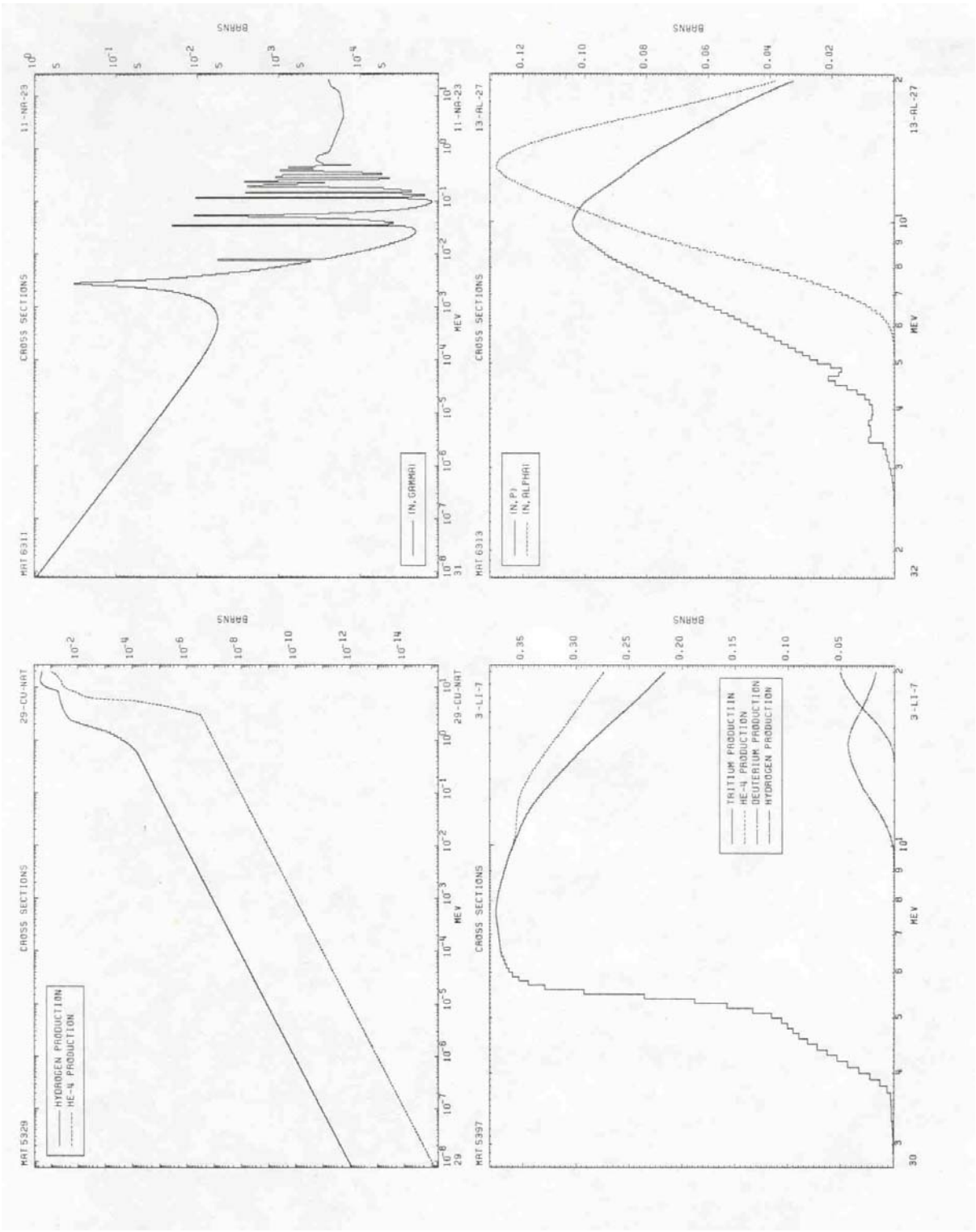

MAT 3020
CROSS SECTIONS
30-ZN-64
(N,P)
BARNS
MEV
30-ZN-64
MAT 4120
(N,N') CROSS SECTIONS
41-NB-93
30.40 KEV
BARNS
MEV
41-NB-93
MAT 4020
CROSS SECTIONS
40-ZR-90
(N,2N)
BARNS
MEV
40-ZR-90
MAT 4520
(N,N') CROSS SECTIONS
45-RH-103
39.75 KEV
BARNS
MEV
45-RH-103

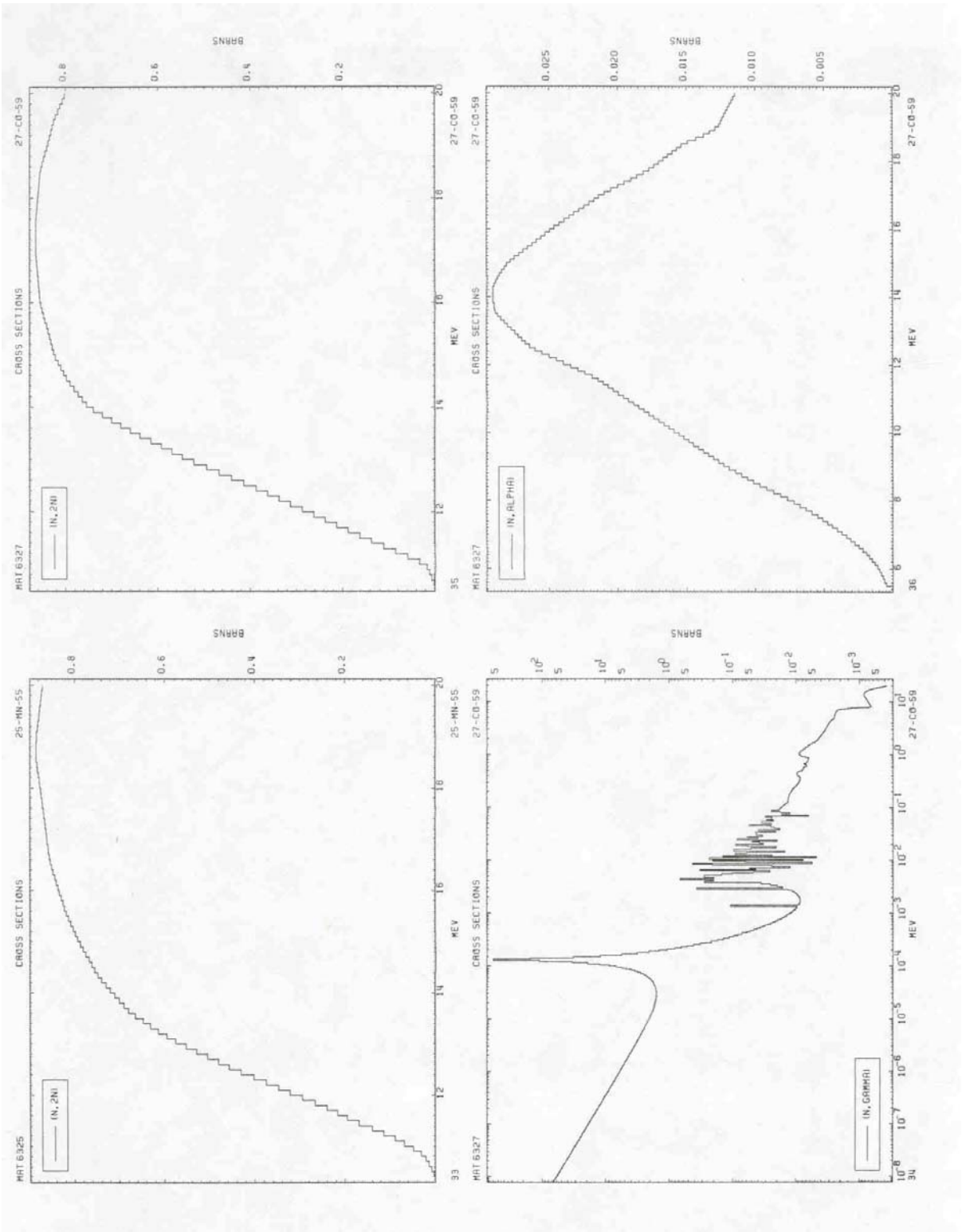

CROSS SECTIONS
BARNS
MEV
MAT 5303
3-LI-6
TRITIUM PRODUCTION
HE-4 PRODUCTION
DEUTERIUM PRODUCTION
HYDROGEN PRODUCTION
MAT 5304
4-BE-9
HE-4 PRODUCTION
TRITIUM PRODUCTION
HYDROGEN PRODUCTION
DEUTERIUM PRODUCTION
MAT 5160
5-B-11
HE-4 PRODUCTION
TRITIUM PRODUCTION
HYDROGEN PRODUCTION
MAT 5275
7-N-14
HYDROGEN PRODUCTION
HE-4 PRODUCTION

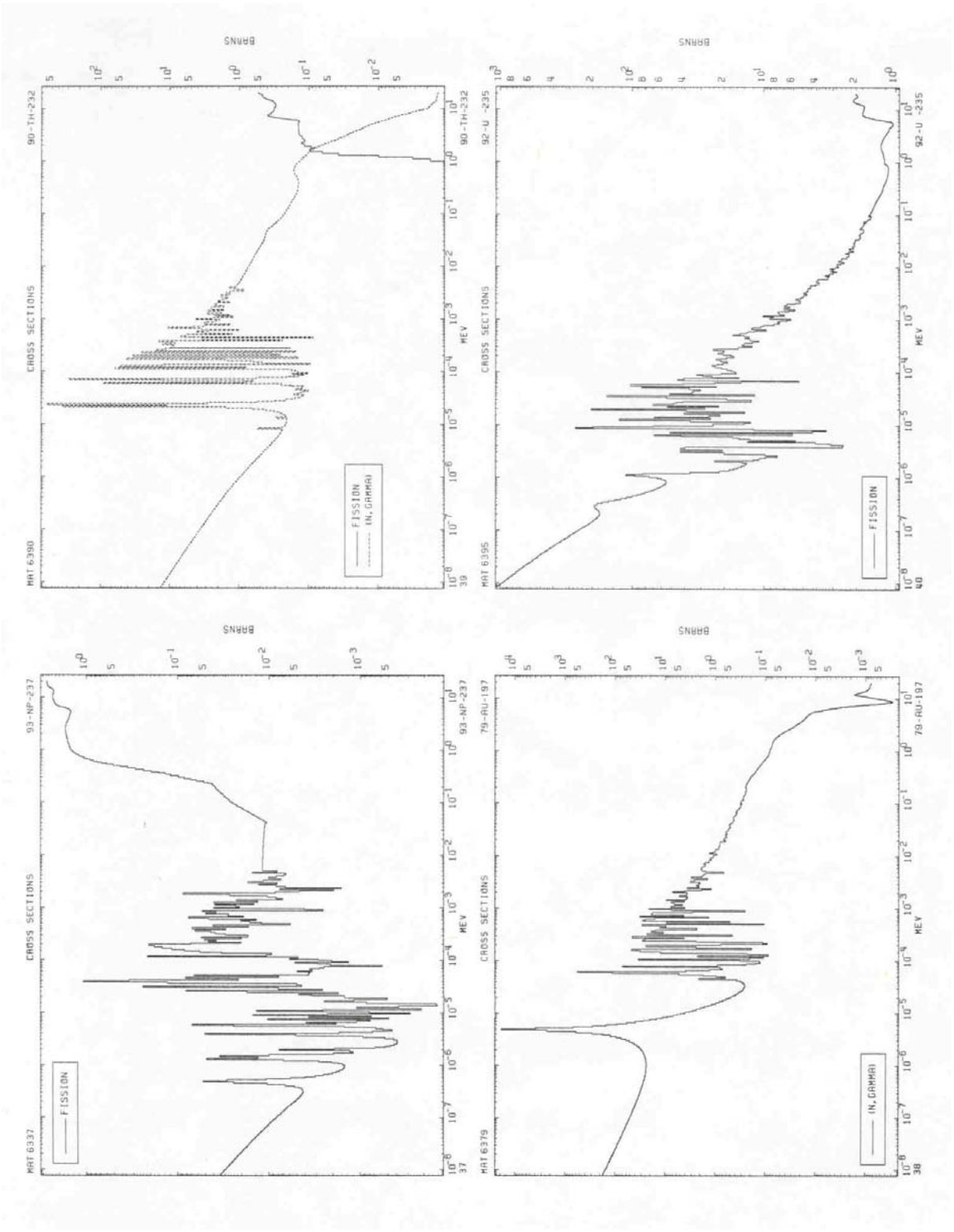

MAT 5305
CROSS SECTIONS
5-B -10
HYDROGEN PRODUCTION
HE-4 PRODUCTION
DEUTERIUM PRODUCTION
BARNS
MEV
17
5-B -10
MAT 5309
CROSS SECTIONS
9-F -19
HE-4 PRODUCTION
HYDROGEN PRODUCTION
BARNS
MEV
19
9-F -19
MAT 5306
CROSS SECTIONS
6-C -NAT
HE-4 PRODUCTION
HYDROGEN PRODUCTION
BARNS
MEV
18
6-C -NAT
MAT 5313
CROSS SECTIONS
13-AL-27
HYDROGEN PRODUCTION
HE-4 PRODUCTION
BARNS
MEV
20
13-AL-27

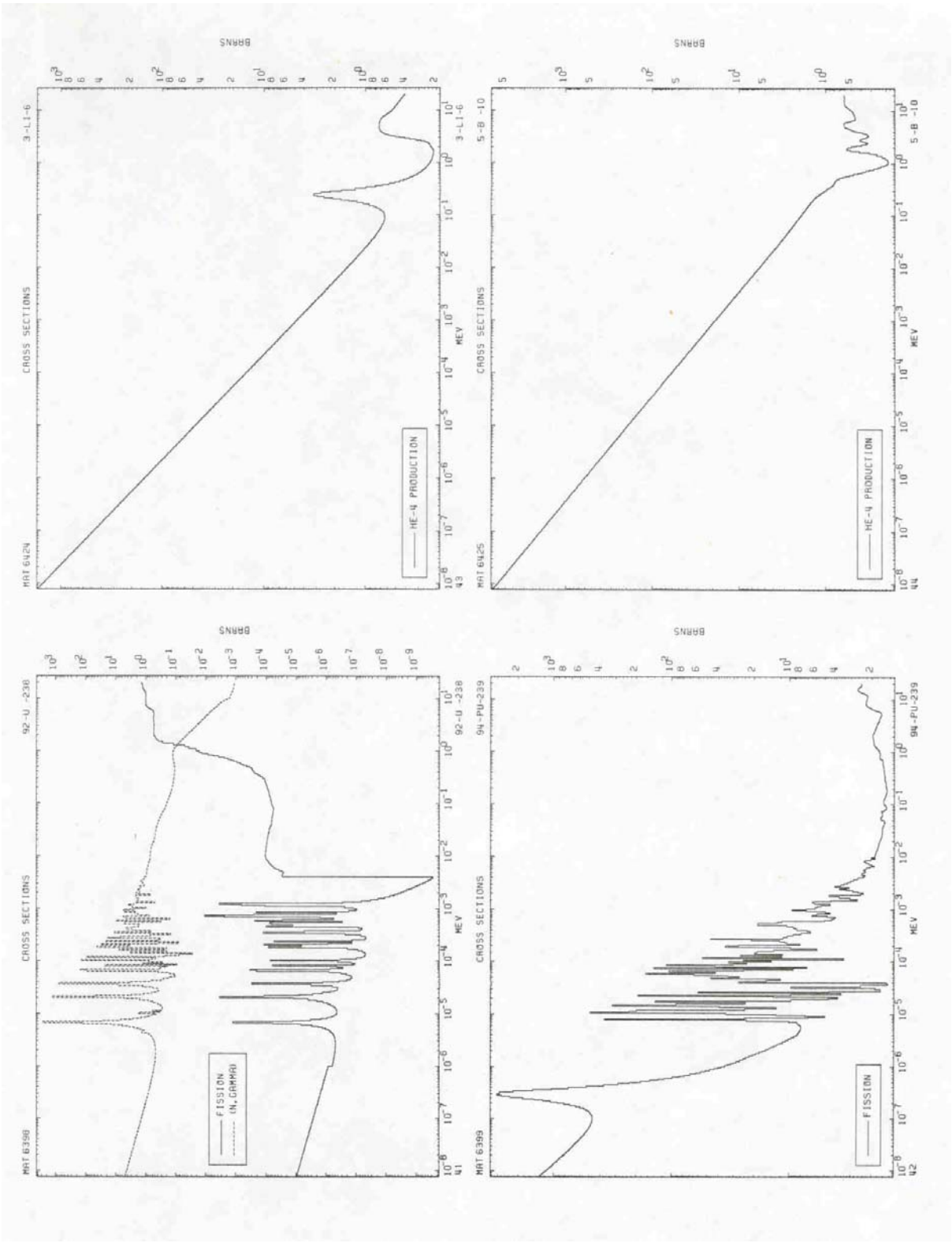

MAT 5314
CROSS SECTIONS
14-SI-NAT
HE-4 PRODUCTION
HYDROGEN PRODUCTION
BARNS
MEV
21
14-SI-NAT
MAT 5323
CROSS SECTIONS
23-V -NAT
HYDROGEN PRODUCTION
HE-4 PRODUCTION
BARNS
MEV
23
23-V -NAT
MAT 5322
CROSS SECTIONS
22-TI-NAT
HYDROGEN PRODUCTION
HE-4 PRODUCTION
BARNS
MEV
22
22-TI-NAT
MAT 5324
CROSS SECTIONS
24-CR-NAT
HE-4 PRODUCTION
HYDROGEN PRODUCTION
HE-3 PRODUCTION
DEUTERIUM PRODUCTION
TRITIUM PRODUCTIIN
BARNS
MEV
24
24-CR-NAT

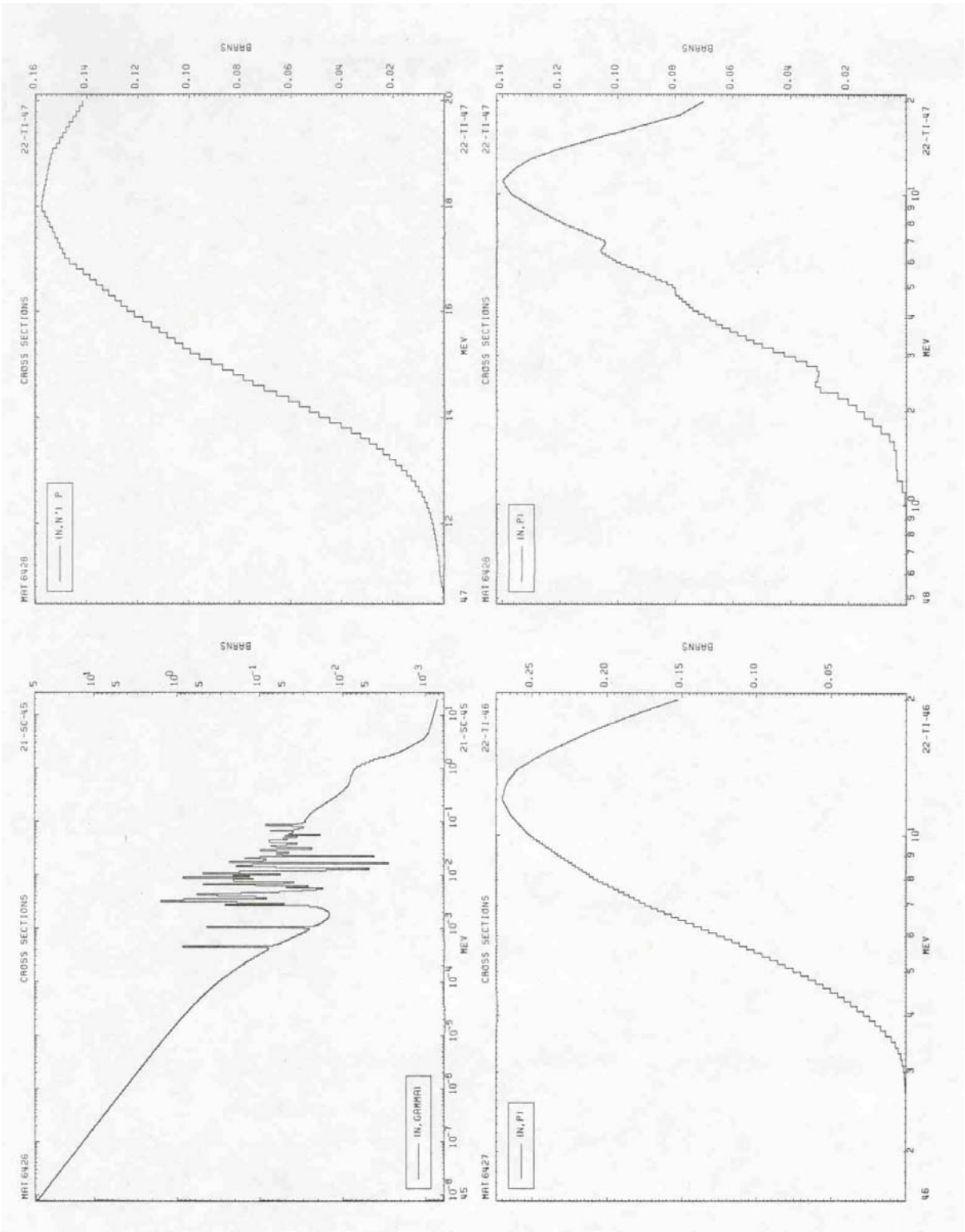

MAT 5325
CROSS SECTIONS
25-MN-55
HE-4 PRODUCTION
HYDROGEN PRODUCTION
BARNS
MEV
25
25-MN-55
MAT 5327
CROSS SECTIONS
27-CO-59
HYDROGEN PRODUCTION
HE-4 PRODUCTION
BARNS
MEV
27
27-CO-59
MAT 5326
CROSS SECTIONS
26-FE-NAT
HYDROGEN PRODUCTION
HE-4 PRODUCTION
BARNS
MEV
26
26-FE-NAT
MAT 5328
CROSS SECTIONS
28-NI-NAT
HYDROGEN PRODUCTION
HE-4 PRODUCTION
DEUTERIUM PRODUCTION
BARNS
MEV
28
28-NI-NAT

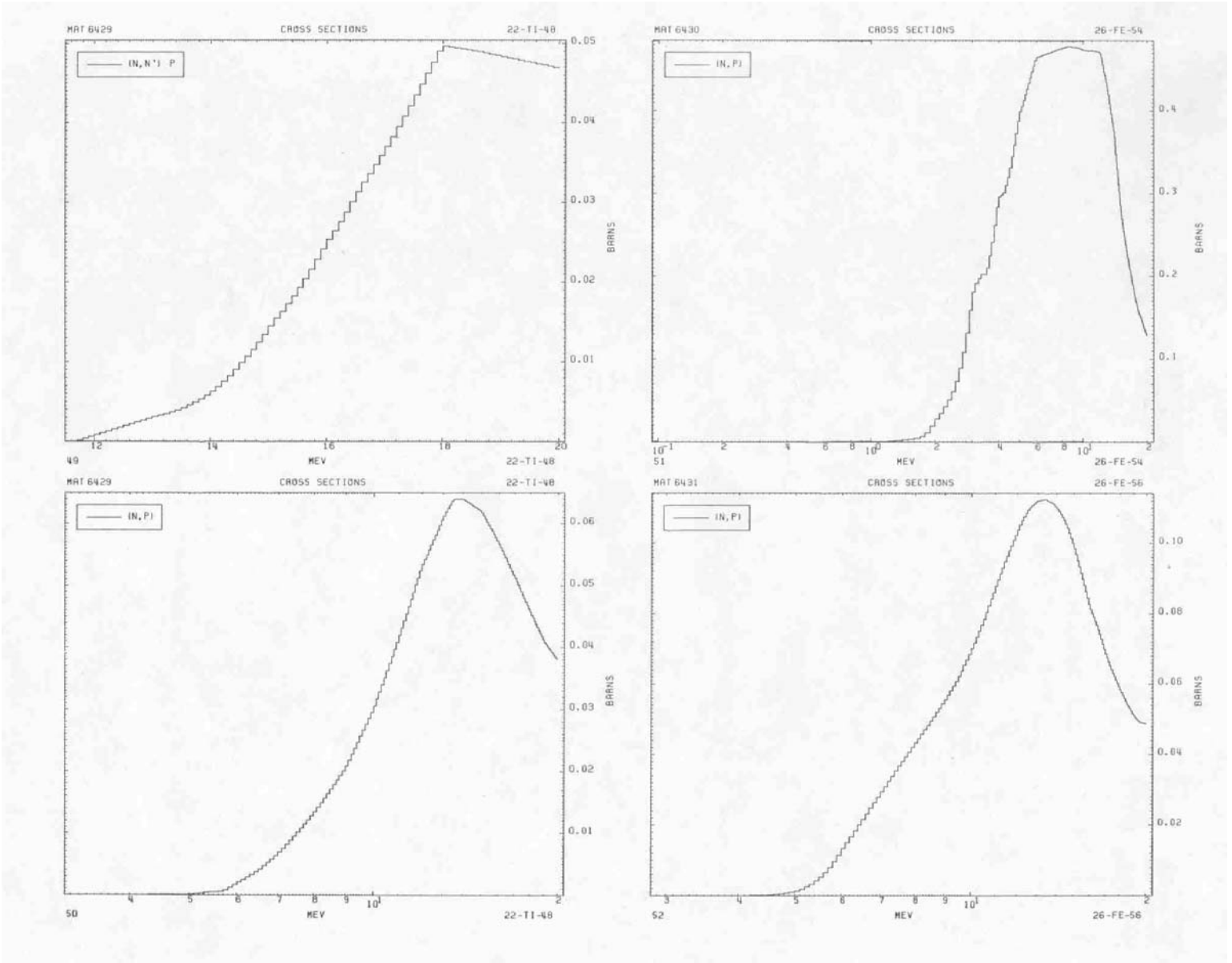

MAT 6311
CROSS SECTIONS
11-NA-23
BARNS
MEV
IN,GAMMA
MAT 6313
CROSS SECTIONS
13-AL-27
BARNS
MEV
IN,P)
IN,ALPHA
MAT 5329
CROSS SECTIONS
29-CU-NAT
BARNS
MEV
HYDROGEN PRODUCTION
HE-4 PRODUCTION
MAT 5397
CROSS SECTIONS
3-LI-7
BARNS
MEV
TRITIUM PRODUCTIN
HE-4 PRODUCTION
DEUTERIUM PRODUCTION
HYDROGEN PRODUCTION

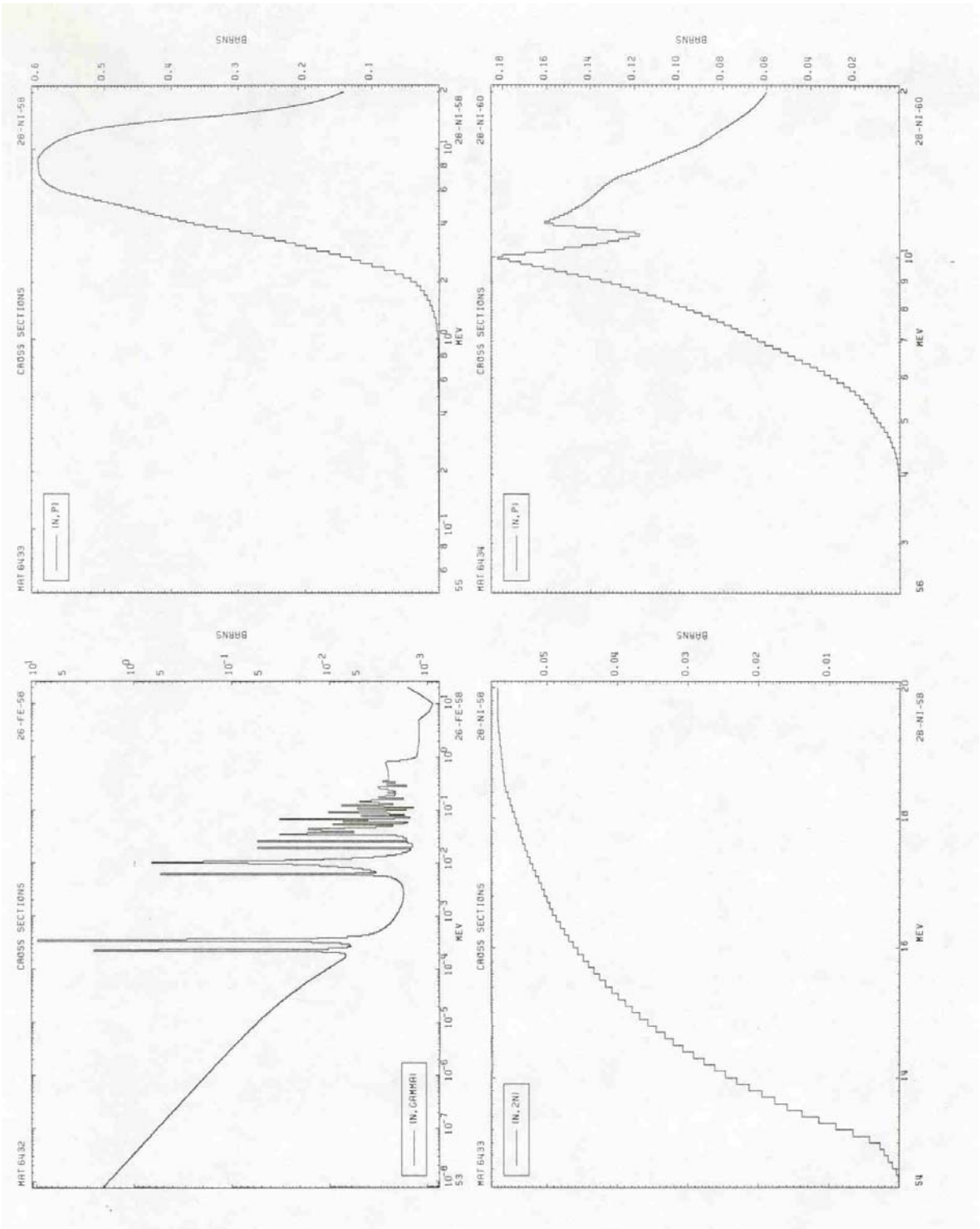

MAT 6325
CROSS SECTIONS
25-MN-55
IN,2N
BARNS
MEV
33
MAT 6327
CROSS SECTIONS
27-CO-59
IN,2N
BARNS
MEV
35
MAT 6327
CROSS SECTIONS
27-CO-59
IN,GAMMA
BARNS
MEV
34
MAT 6327
CROSS SECTIONS
27-CO-59
IN,ALPHA
BARNS
MEV
36

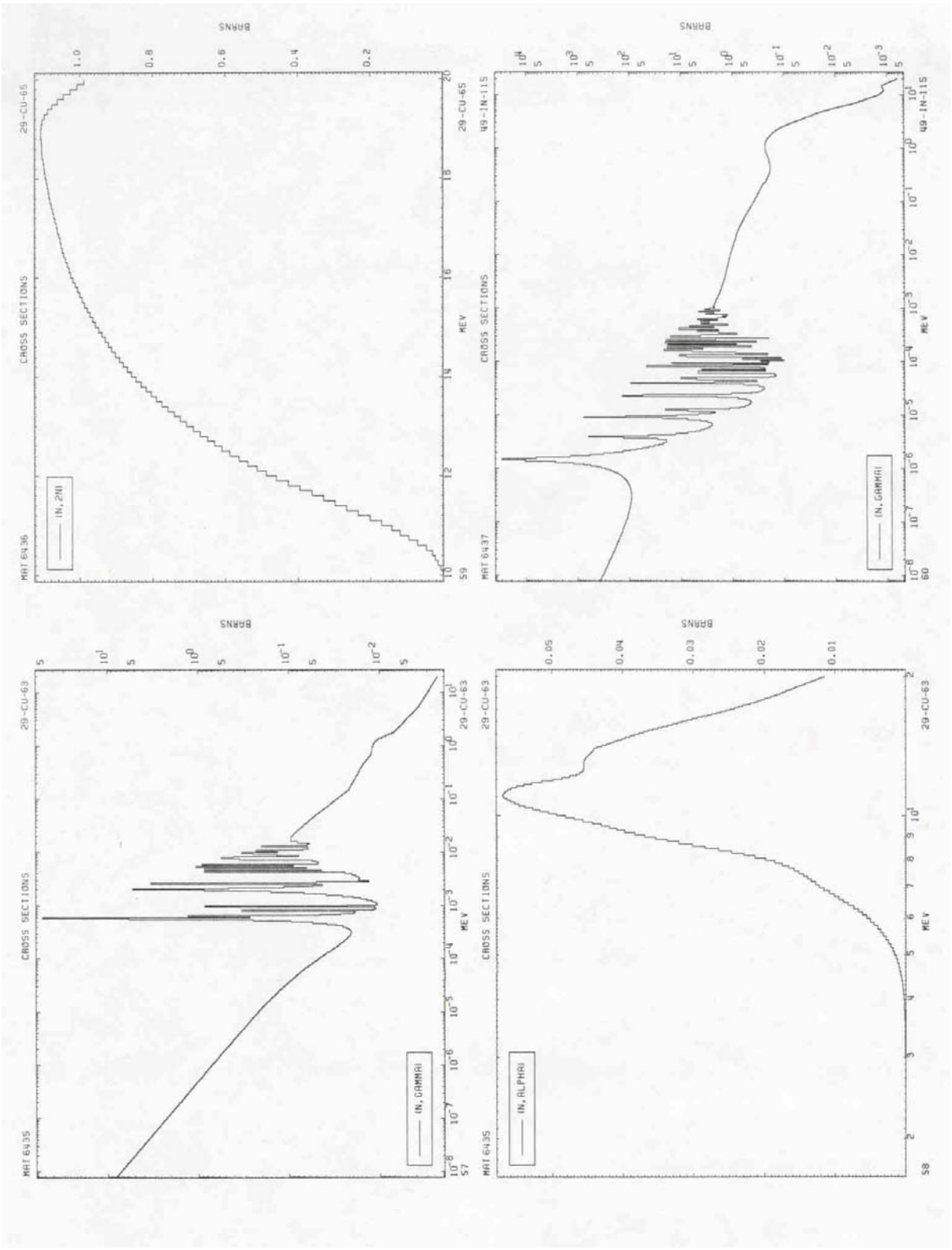

MAT 6390
CROSS SECTIONS
90-TH-232
BARNS
MEV
FISSION
(N,GAMMA)
MAT 6395
92-U -235
FISSION
MAT 6337
93-NP-237
FISSION
MAT 6379
79-AU-197
(N,GAMMA)

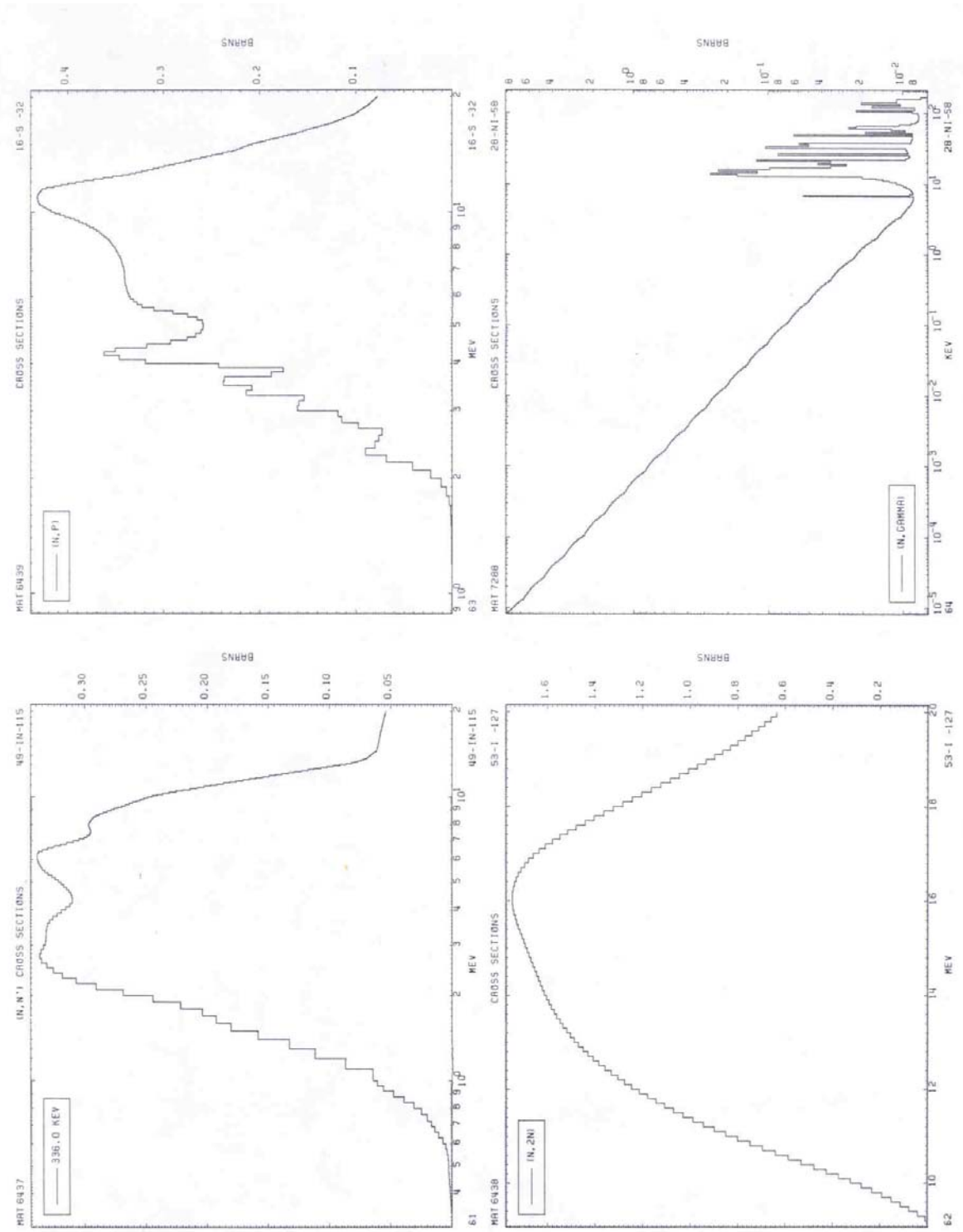

MAT 6424
CROSS SECTIONS
3-LI-6
HE-4 PRODUCTION
BARNS
MEV
MAT 6425
5-B -10
MAT 6398
92-U -230
FISSION
(N,GAMMA)
92-U -238
MAT 6399
94-PU-239

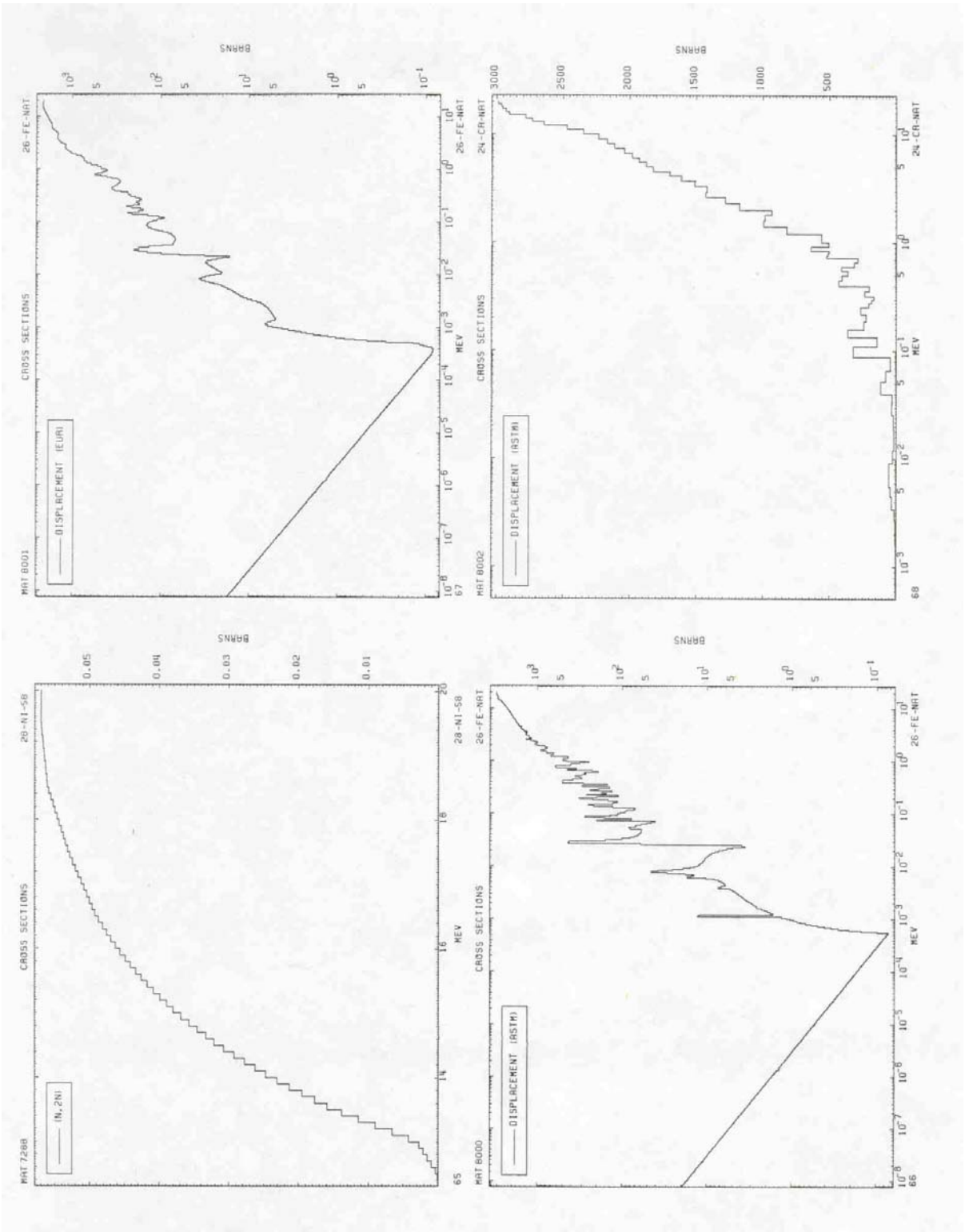

CROSS SECTIONS
MAT 6426
(N,N'1 P)
(N,P)
(N,GAMMA)
BARNS
MEV
22-11-47
21-SC-45
22-11-46

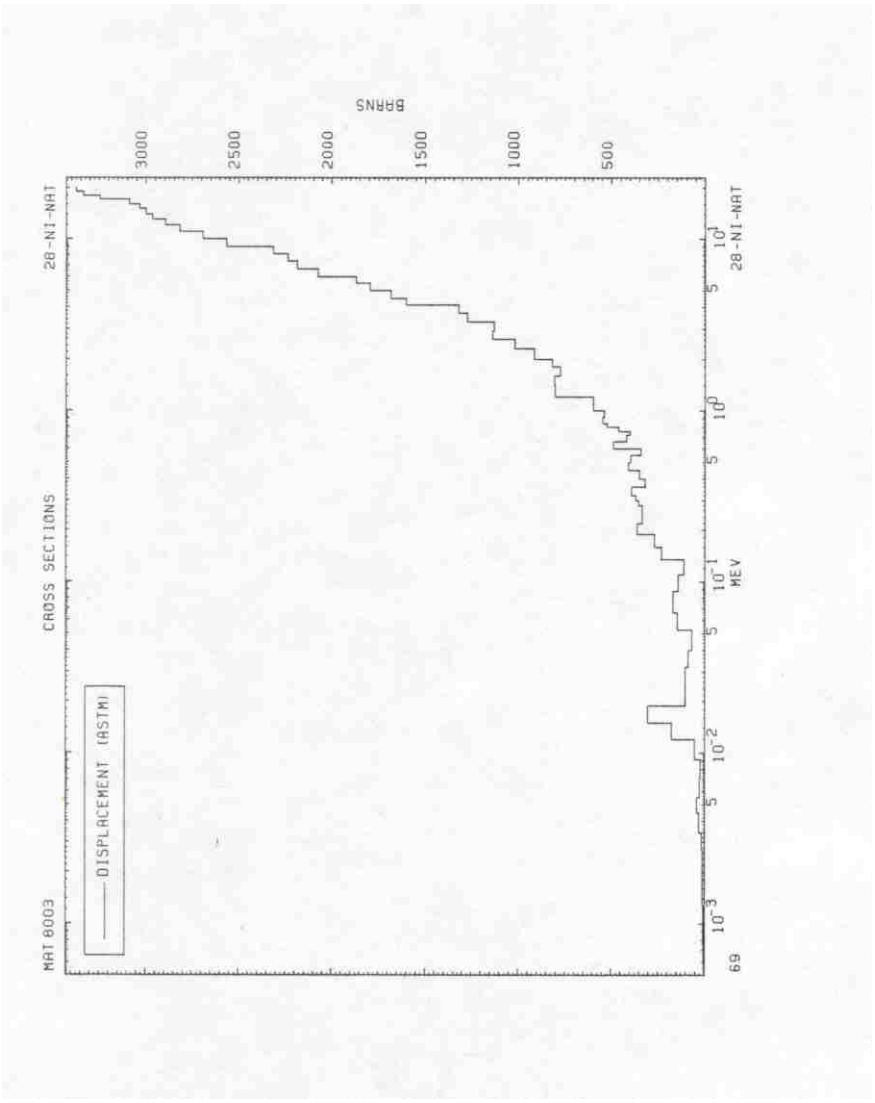

MAT 6429
CROSS SECTIONS
22-TI-48
(N,N'1 P)
0.05
0.04
0.03
0.02
0.01
BARNS
12
14
16
18
20
49
MEV
22-TI-48
MAT 6430
CROSS SECTIONS
26-FE-54
(N,P1)
0.4
0.3
0.2
0.1
BARNS
51
MEV
26-FE-54
MAT 6429
CROSS SECTIONS
22-TI-48
(N,P1)
0.06
0.05
0.04
0.03
0.02
0.01
BARNS
50
MEV
22-TI-48
MAT 6431
CROSS SECTIONS
26-FE-56
(N,P1)
0.10
0.08
0.06
0.04
0.02
BARNS
52
MEV
26-FE-56


MAT 6432
CROSS SECTIONS
26-FE-58
(N,GAMMA)
MAT 6433
CROSS SECTIONS
28-NI-58
(N,2N)
MAT 6434
CROSS SECTIONS
28-NI-60
(N,P)
MAT 6439
CROSS SECTIONS
28-NI-58
(N,P)
BARNS
MEV


MAT 6436
CROSS SECTIONS
29-CU-65
BARNS
MEV
(N,2N)
MAT 6437
CROSS SECTIONS
49-IN-115
BARNS
MEV
(N,GAMMA)
MAT 6435
CROSS SECTIONS
29-CU-63
BARNS
MEV
(N,GAMMA)
MAT 6435
CROSS SECTIONS
29-CU-63
BARNS
MEV
(N,ALPHA)

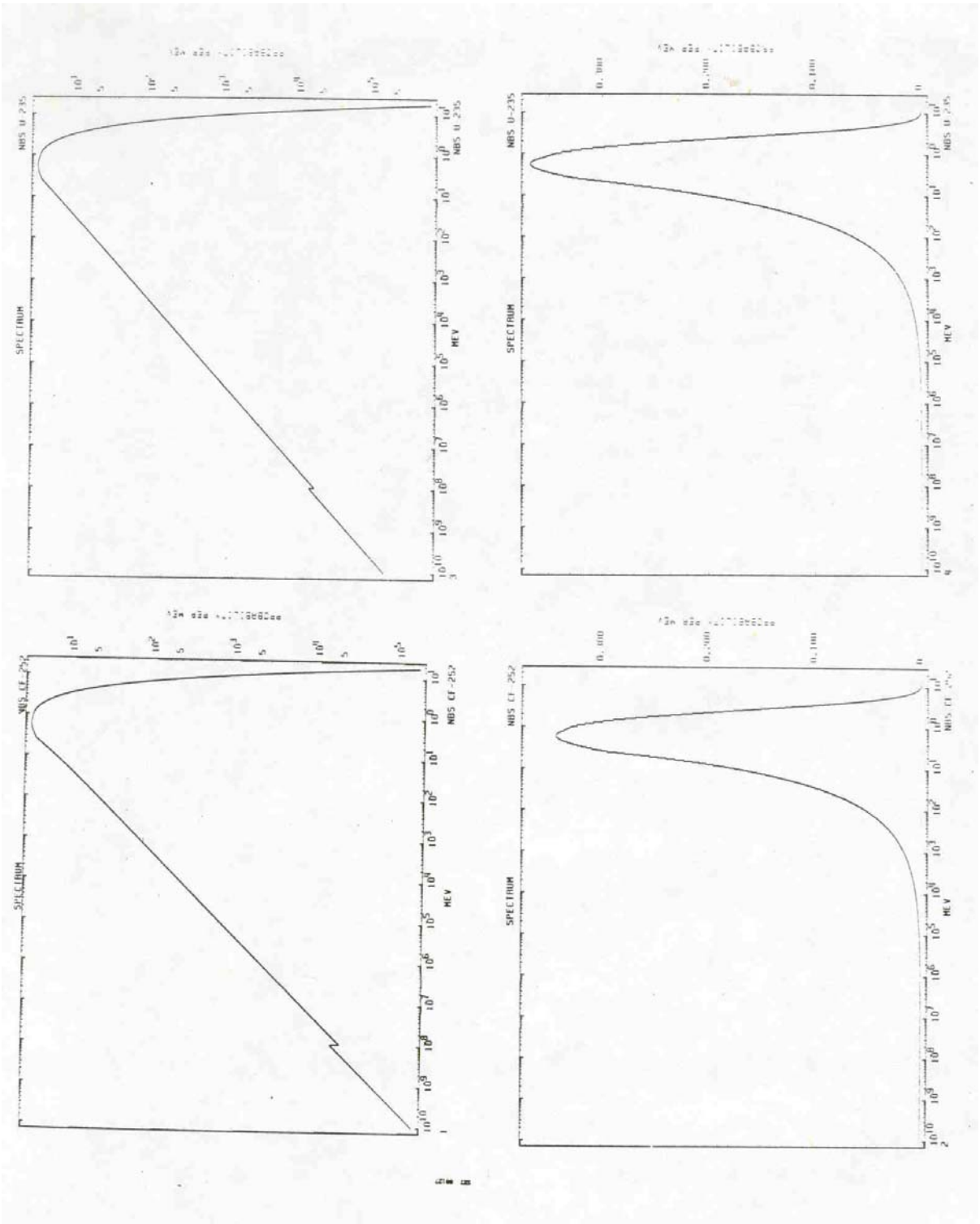

MAT 6439
CROSS SECTIONS
16-S -32
(N,P)
MEV
BARNS
MAT 7200
CROSS SECTIONS
28-NI-58
(N,GAMMA)
KEV
BARNS
MAT 6437
(N,N'1 CROSS SECTIONS
49-IN-115
336.0 KEV
MEV
BARNS
MAT 6438
CROSS SECTIONS
53-I -127
(N,2N)
MEV
BARNS

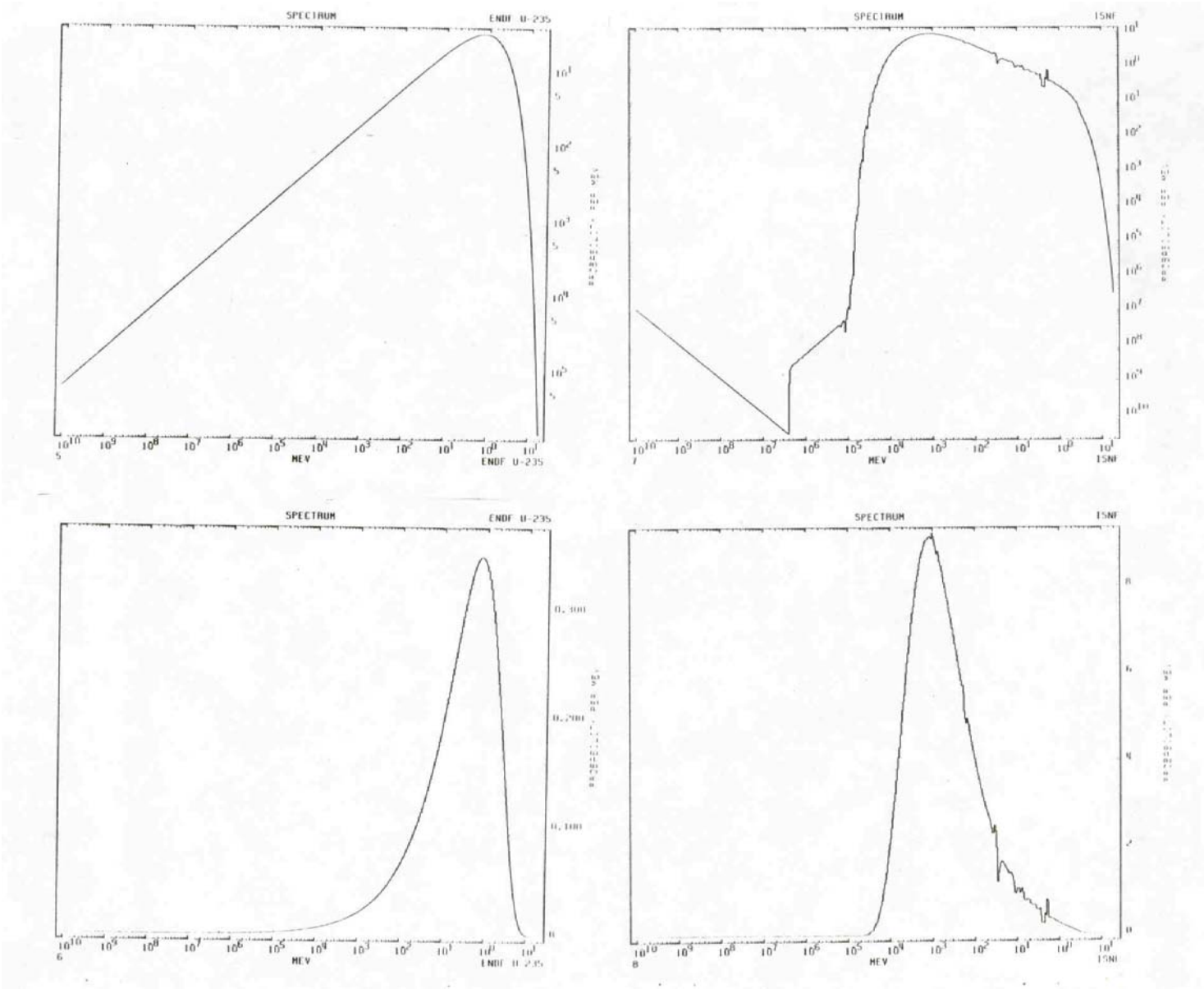

MAT 7200
CROSS SECTIONS
28-NI-58
(N,2N)
BARNS
MEV
MAT 8000
CROSS SECTIONS
26-FE-NAT
DISPLACEMENT (ASTM)
BARNS
MEV
MAT 8001
CROSS SECTIONS
26-FE-NAT
DISPLACEMENT (EURI)
BARNS
MEV
MAT 8002
CROSS SECTIONS
24-CR-NAT
DISPLACEMENT (ASTM)
BARNS
MEV

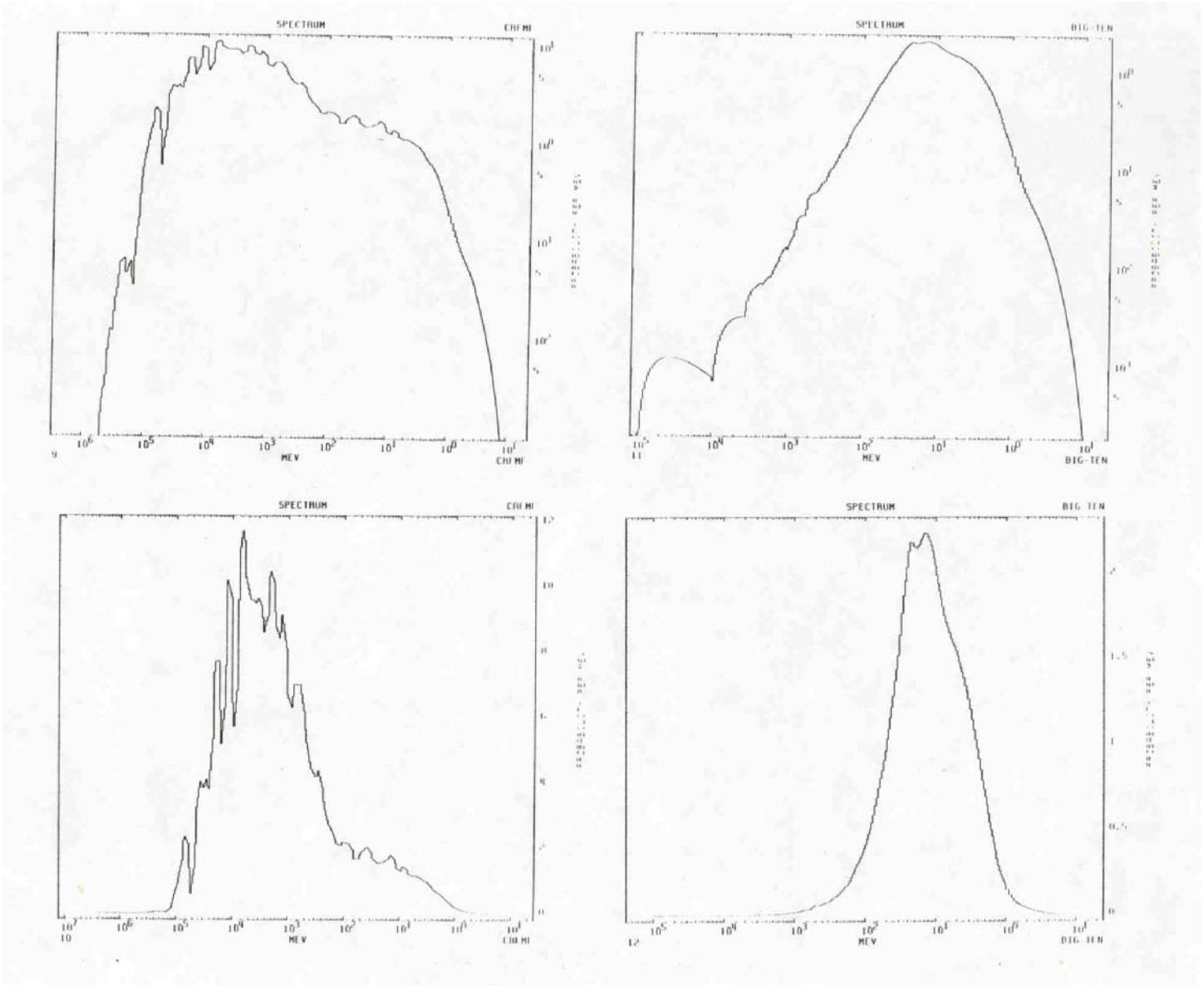

MAT 8003
CROSS SECTIONS
28-NI-NAT
DISPLACEMENT (ASTM)
BARNS
3000
2500
2000
1500
1000
500
69
10^{-3}
5
10^{-2}
5
10^{-1}
5
10^{0}
5
10^{1}
MEV
28-NI-NAT

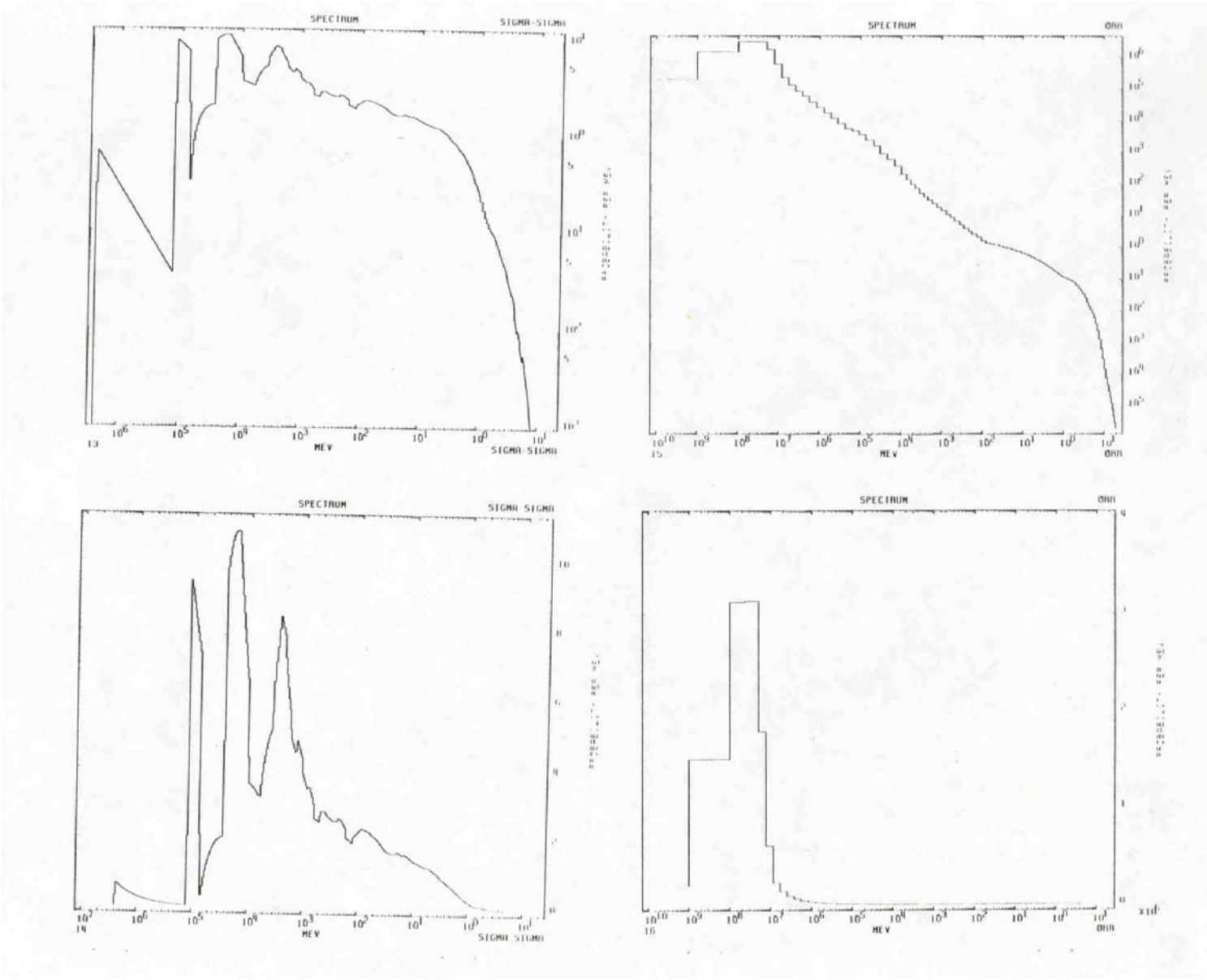
X. Plots of Benchmark Spectra

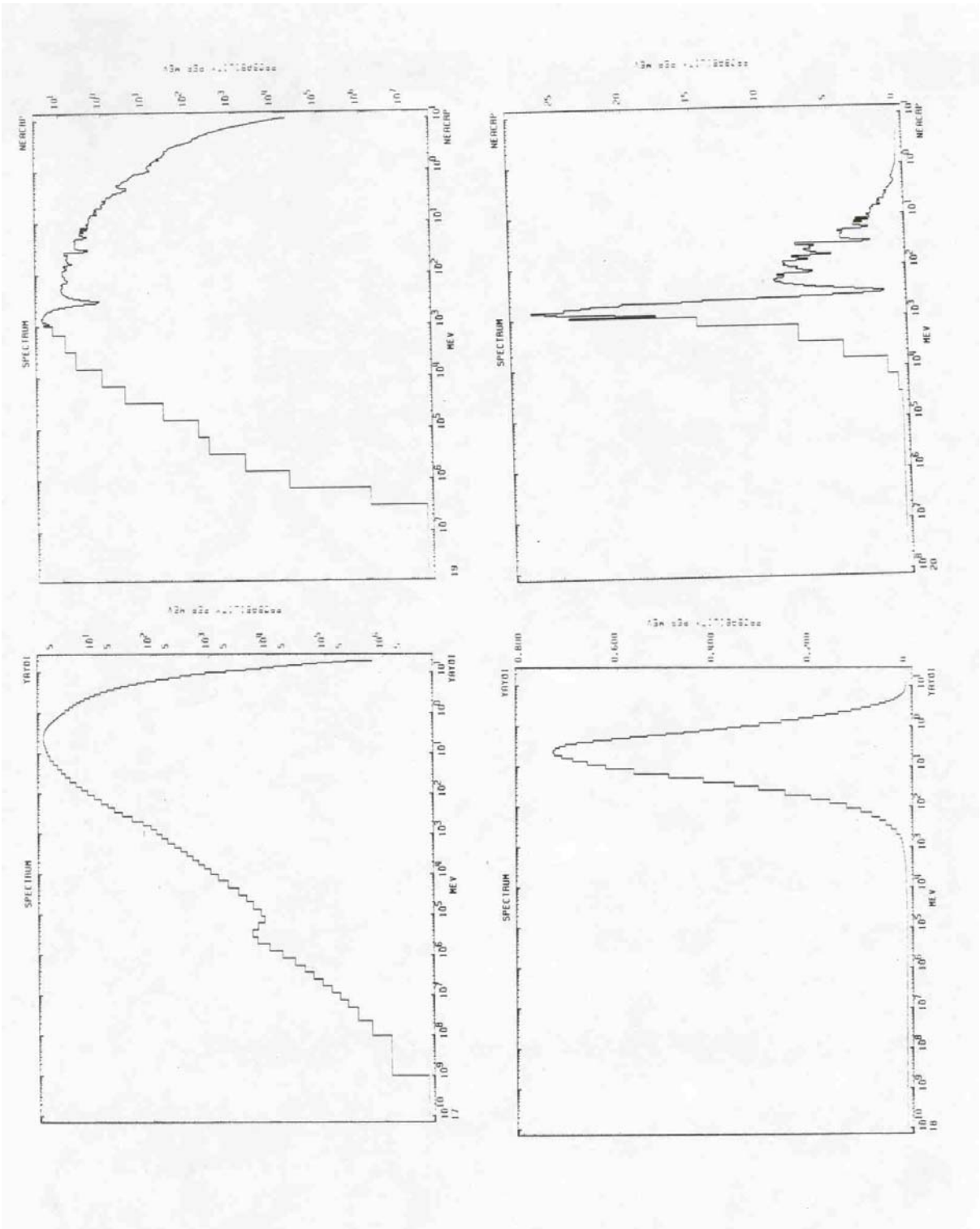
In the following section the benchmark spectra are presented in normalized form (normalized to unity when integrated over energy between 10-4 ev and 20 MeV). The spectra are presented as flux per unit MeV vs. MeV (note, this is not flux per unit lethargy).


NBS U-235
SPECTRUM
MEV
NBS CF-252
SPECTRUM
MEV


SPECTRUM
ENDF U-235
MEV
ENDF U-235
SPECTRUM
ISNF
MEV
ISNF
SPECTRUM
ENDF U-235
MEV
ENDF U-235
SPECTRUM
ISNF
MEV
ISNF


SPECTRUM
CRFMI
MEV
CRFMI
SPECTRUM
BIG-TEN
MEV
BIG-TEN
SPECTRUM
CRFMI
MEV
CRFMI
SPECTRUM
BIG TEN
MEV
BIG TEN


SPECTRUM
SIGMA-SIGMA
MEV
SIGMA-SIGMA
SPECTRUM
ORR
MEV
ORR
SPECTRUM
SIGMA SIGMA
MEV
SIGMA SIGMA
SPECTRUM
ORR
MEV
ORR


NEACRP
SPECTRUM
MEV
YAYOI