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Comparison of the ENDF/B-V and SOKRATOR Evaluations of ^{235}U, ^{239}Pu, ^{240}Pu and ^{241}Pu at Low Neutron Energies

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ABSTRACT

The U.S. and U.S.S.R.'s most recent evaluations of ^{235}U, ^{239}Pu, ^{240}Pu and ^{241}Pu are compared over the thermal region and over the first few resonances. The two evaluations rest on essentially the same experimental data base and the differences reflect different approaches to the representation of the cross sections or different weightings of the experimental results. It is found that over the thermal and resolved ranges the two evaluations are very similar. Some differences in approaches are briefly discussed.

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I. INTRODUCTION

In this paper we present a brief comparison of the U.S. evaluation ENDF/B-V and the USSR evaluation SOKRATOR of the nuclides ^{235}U, ^{239}Pu, ^{240}Pu and ^{241}Pu, over the thermal energy region and over the first few resolved resonances.[1-8] The emphasis is on comparing methods of representing the evaluated cross sections since the comparison of evaluated and measured resonance parameters is the subject of other papers at this meeting.

The SOKRATOR evaluations were "translated" into the ENDF/B-V format by the Nuclear Data Section of the IAEA.[9] This ENDF/B Version of SOKRATOR forms the basis for the comparison presented here. In the next few sections we discuss successively the file structure, the scattering radius, the cross sections below 1 eV, and the resolved resonance region. General comments on the cross-section representations are collected in the concluding section. For ease in presentation and for conciseness, much of this comparison is presented in tabular and graphical form.

II. COMPARISON OF THE ENDF/B-V AND SOKRATOR FILE STRUCTURES

The general file structures for ^{235}U, ^{239}Pu, ^{240}Pu and ^{241}Pu are compared in Tables I to IV. All the SOKRATOR evaluations, as well as the ^{235}U and ^{239}Pu ENDF/B-V evaluations, represent the cross sections below 1 eV with point data (MF=3). In the ENDF/B-V representation of ^{241}Pu this pointwise description extends to 2.873 eV, whereas in the ENDF/B-V representation of ^{240}Pu the resolved resonance region starts at 10^{-5} eV.

The ENDF/B-V and SOKRATOR representations of the ^{235}U, ^{239}Pu and ^{240}Pu cross sections over the resolved resonance range use Breit-Wigner resonance parameters. The ENDF/B-V representation of the ^{241}Pu cross sections over the resolved resonance region (2.873 to 100 eV) uses the

Adler-Adler formalism whereas the corresponding SOKRATOR evaluation uses a "modified Adler-Adler representation" which is incompatible with ENDF/B formats as will be shown in Section VI. In the ENDF/B-V representation of the ^{235}U and ^{239}Pu cross sections over the resolved resonance region the resonance contributions are supplemented by a point-data file (MF=3). In all the SOKRATOR evaluations this point data file vanishes over the resonance region.

The SOKRATOR ^{235}U evaluation has an alternate representation of the resolved range in terms of "modified Adler-Adler parameters."[5]

As can be seen from Tables I to IV, the unresolved representation in the SOKRATOR evaluations extends to 100 or 150 keV (except for ^{239}Pu, where no unresolved parameters are given). The unresolved resonance range for ENDF/B-V extends to 25 keV for ^{235}U and ^{239}Pu and to 40 keV for ^{240}Pu and ^{241}Pu. Since the ENDF/B-V and SOKRATOR formats for the unresolved resonance range are not compatible,[5] this range will not be discussed here.

III. THE ENDF/B-V AND SOKRATOR SCATTERING RADIUS

The values of the scattering radius, AP, in the ENDF and SOKRATOR evaluations differ by 10 to 15% for the four isotopes considered. The scattering radius in the ENDF evaluations is derived from the relation:

$$AP=\left(\frac{\sigma_p}{4\pi}\right)^{1/2} \qquad (1)$$

where σ_p is the potential scattering cross section. For instance, in the ^{235}U ENDF/B-V evaluation the scattering radius, $AP=0.957\times10^{-12}$ cm, was obtained by (1) from the value σ_p=11.7b recommended by F. Poortmans *et al.*[10] on the basis of their measurement of the scattering cross section of ^{235}U below 100 eV.[11]

The values of the scattering radius given in the SOKRATOR evaluations are smaller and are probably computed from an expression relating the scattering radius to the mass number A such as:[12]

$$AP = (.123A^{1/3} + .08) \times 10^{-12} \text{ cm} \qquad (2)$$

IV. ENDF/B-V AND SOKRATOR EVALUATIONS IN THE THERMAL ENERGY REGION

The ENDF/B-V and SOKRATOR evaluations of ^{235}U, ^{239}Pu, ^{240}Pu and ^{241}Pu in the thermal energy region are compared in Tables V-IX and in Figs. 1-16. As can be seen from the figures, except for the scattering cross sections of the fissile isotopes, the two evaluations are fairly consistent. This agreement is not surprising, since both evaluations are based in part on the result of the periodic evaluations of the thermal parameters of the fissile nuclei performed by an international team of experts under the sponsorship of the IAEA Nuclear Data Section.[13-15]

The scattering cross sections of these heavy nuclei are difficult to measure, particularly at low energy where Bragg scattering and extinction are important. Most evaluated scattering cross sections are compiled from resonance parameters, except for the SOKRATOR ^{235}U evaluation where the scattering cross section shows considerable structure and was probably obtained directly from a measurement (Fig. 2).

For a more precise comparison of the evaluations in the thermal region it is convenient to parameterize the cross sections with the 2200 m/s value, σ_o, and the Westcott g-factor[16] at 294 K.

The values of σ_o and g for the four isotopes are compared in Tables V to VIII and are generally consistent to within a few percent, except for the ^{240}Pu fission cross section, which is only of the order of 50 mb, and the ^{235}U and ^{239}Pu scattering cross sections, also relatively small.

The thermal parameters for the fission and capture cross sections of the fissile isotopes are compared with results of other evaluations[13,14,17,18] in Table IX. The ENDF/B-V ^{235}U thermal region is based on the work of Leonard *et al.*[17] The ENDF/B-V thermal parameters are consistent (within quoted errors) with the 1975-IAEA values,[14] except for g_γ for ^{235}U and ^{239}Pu. The SOKRATOR evaluations of ^{235}U and ^{239}Pu have somewhat smaller fission cross sections and somewhat larger capture cross sections. As discussed by Lemmel,[15] there are still unexplained discrepancies in the "best values" of the thermal parameters, and the differences between the ENDF/B-V and SOKRATOR evaluations reflect different interpretations of the probable cause of these discrepancies.

V. ENDF/B-V AND SOKRATOR EVALUATIONS IN THE RESOLVED RANGES

The ENDF and SOKRATOR evaluated ^{235}U Breit-Wigner resonance parameters for levels up to 20 eV are compared in Table X. In general corresponding resonance parameters agree within 10% or better. SOKRATOR assigns a J-value to each level, and these assignments are consistent with the spin determination of Moore *et al.*,[19] based on the measurements with polarized beams and polarized targets of Keyworth *et al.*[20] The ENDF/B-V evaluation assigns a fictitious J=3.5 to all levels. Both the ENDF and SOKRATOR evaluations represent the cross sections up to 20 eV with about 30 levels, whereas Moore *et al.*[19] observe between 40 and 50 levels in the same interval.

As is well known, the asymmetries in the resonance shape of the fissile nuclides cannot be represented accurately with the Breit-Wigner formalism.[21-23] The ENDF/B-V supplements the resonance description of the cross sections with "smooth files" (MF=3), which are the differences between the evaluated cross sections and the Breit-Wigner representations.

These "smooth files" include considerable structure and to a large extent negate the advantages of a resonance representation; these files must be numerically Doppler broadened and self-shielded. Figure 17 shows the "smooth file" for the ^{235}U fission cross section.

In the SOKRATOR evaluations these "smooth files" vanish over the resonance region, so that the resonance asymmetries are not correctly described in the ^{235}U evaluation using Breit-Wigner parameters. SOKRATOR also has a representation of the ^{235}U resonance region, using "modified Adler-Adler parameters," but this representation is incompatible with ENDF/B formats as will be discussed in the next section.

The ENDF and SOKRATOR evaluated ^{239}Pu Breit-Wigner resonance parameters for levels up to 25 eV are compared in Table XI. As in the case of ^{235}U these parameters agree within 10% or better for the more important levels. As for ^{235}U, the ENDF/B-V representation is supplemented by a "smooth file" (MF=3) which is not "smooth". The MF=3 contribution to the ^{239}Pu fission cross section is illustrated in Fig. 18.

The ENDF and SOKRATOR evaluated ^{240}Pu Breit-Wigner resonance parameters for levels up to 100 eV are compared in Table XII. The values of the neutron and capture widths are mostly consistent to within 10% or better. The values of the fission widths differ by factors of 5 or even 10! But these fission widths are very small and hence difficult to measure. The ENDF/B-V values of the fission widths of the first three levels were obtained from the evaluation of Weigmann *et al.*[24] and the levels for which no measurements of the fission width had been made were assigned a fission width of 20 meV. The fission widths of SOKRATOR were obtained from an area analysis of the data of Byers *et al.*[25] and Migneco *et al.*[26] For the important level at 1.058 eV, the neutron and capture widths of the two evaluations differ by about 3% but the capture cross sections below 0.1 eV, proportional to the product of these two widths, are fully consistent.

The resolved range of ^{241}Pu is represented by Adler-Adler parameters in the ENDF/B-V evaluation, and by "modified Adler-Adler parameters" in the SOKRATOR evaluation. As discussed in the next section, these two formalisms are not compatible, so that a meaningful comparison of resonance parameters cannot be made.

VI THE SOKRATOR MODIFIED ADLER-ADLER FORMALISM

In the resonance region, some SOKRATOR evaluations[5,8] use a "modified Adler-Adler formalism" in which a reaction cross section is represented by:

$$\sigma_{n,r}(E) = \frac{2.6\times10^6}{E} \sum_{i=1}^{N} \left(G_i^{(r)} \psi(x,\theta) + H_i^{(r)} \chi(x,\theta) \right) \tag{3}$$

where N is the number of resonances taken into account, $G_i^{(r)}$ and $H_i^{(r)}$ are the modified Adler-Adler parameters for the i-th level and the r-th reaction and $\psi(x,\theta)$ and $\chi(x,\theta)$ are the Voight profiles[27,28] for,

$$x = \frac{\mu-E}{\nu} \quad \text{and} \quad \theta = 2\frac{\nu}{\Delta}$$

where μ is the resonance energy, ν the resonance half-width and Δ the Doppler width. If the Doppler broadening is negligible, the first Voigt profile becomes:

$$\psi(x,\infty) = \frac{1}{1+x^2} = \frac{\nu^2}{(\mu-E)^2 + \nu^2} . \tag{4}$$

If we consider a single level (H=0) and no broadening, expression (3) reduces to:

$$\sigma_{n,r}(E) = \frac{2.6\times10^6}{E} G^{(r)} \frac{\nu^2}{(\mu-E)^2 + \nu^2} . \tag{5}$$

By identifying (5) with the single-level Breit-Wigner formula we see that for a single level $G^{(r)}$ reduces to:

$$G^{(r)} \simeq g \frac{\Gamma_n \Gamma_r}{\Gamma^2} \qquad (6)$$

In the ENDF/B formulation,[29] as in the original Adler-Adler formulation,[30] the reaction cross section is represented by:

$$\sigma_{n,r}(E) = \frac{2.6\times10^6}{4\ E^{1/2}} \left(\frac{A+1}{A}\right)^2 \sum_{i=1}^{N} \left(\frac{G^*}{\nu}\ \psi + \frac{H^*}{\nu}\ \chi\right) \qquad (7)$$

where we use G* and H* for the "regular Adler-Adler parameters. Using (4), for a single level and no broadening, (7) reduces to:

$$\sigma_{n,r}(E) = \frac{2.6\times10^6}{4\ E^{1/2}} \left(\frac{A+1}{A}\right)^2 G^* \frac{\nu}{(\mu-E)^2 + \nu^2}\ . \qquad (8)$$

By identifying (8) with the single-level Breit-Wigner formula we see that, for a single level G* reduces to:

$$G^* \simeq 2g\Gamma_n^{\circ} \frac{\Gamma_r}{\Gamma}\ . \qquad (9)$$

It is clear, from comparing (3) with (7) that the cross sections in the modified Adler-Adler formalism and in the standard Adler-Adler formalism do not have the same energy dependance. As can be seen from (6), taking the modified Adler-Adler parameters as constant corresponds to neglecting the $E^{1/2}$-dependence of the neutron width due to the s-wave penetration factor.

Because of this difference in energy dependence it is not very meaningful to compare the ENDF Adler-Adler parameters to the SOKRATOR modified Adler-Adler parameters.

VII. CONCLUSION

The ENDF and SOKRATOR evaluations of the low energy cross sections of the four isotopes examined are fairly consistent. The scattering radius of the SOKRATOR evaluations are systematically lower by 10 to 15% than those of ENDF and are not consistent with low energy potential scattering cross section data. The ENDF and SOKRATOR values of the fission and capture thermal parameters of the fissile isotopes are consistent within a few percent. The ENDF/B-V values are consistent, within quoted uncertainties, with the 1975 IAEA evaluation.[14] The SOKRATOR values tend to be lower in fission and higher in capture. Since the SOKRATOR values of $\overline{\nu}$ also tend to be lower than those of ENDF, SOKRATOR's computed criticality constants should be lower than those computed with ENDF/B-V.

Both ENDF/B-V and SOKRATOR represent the cross sections of the important nuclides ^{235}U and ^{239}Pu in the resolved resonance range, with Breit-Wigner parameters. This is somewhat surprising since it has been known, for more than twenty years, that the Breit Wigner resonance formula is a poor approximation for the fissile nuclides, even at low energies.[21-23] Several practical multilevel formalisms have been developed for the purpose of representing the low-energy cross sections of the fissile isotopes.[30-32] Several resonance analysis codes are available.[33,34] The ENDF/B procedures manual[30] recommends that the low-energy cross sections of the fissile isotopes be analysed with the Reich-Moore formalism,[32] because it is unitary and yields R-matrix resonance parameters. The Reich-Moore representation can then be converted into an equivalent Adler-Adler representation by partial expansion,[35,36] for ease in Doppler broadening. Unfortunately for ENDF/B-V, the recommended procedure has been followed only for ^{233}U, and it has not been followed in any of the SOKRATOR evaluations examined here.

Finally, the "modified Adler-Adler formalism" used in some SOKRATOR evaluations is not compatible with the "standard Adler-Adler formalism."[30] For a single level it does not reduce to the correct energy dependence of the cross sections; but viewed as an arbitrary parameterization it may permit an adequate representation of the cross sections of the fissile nuclides.

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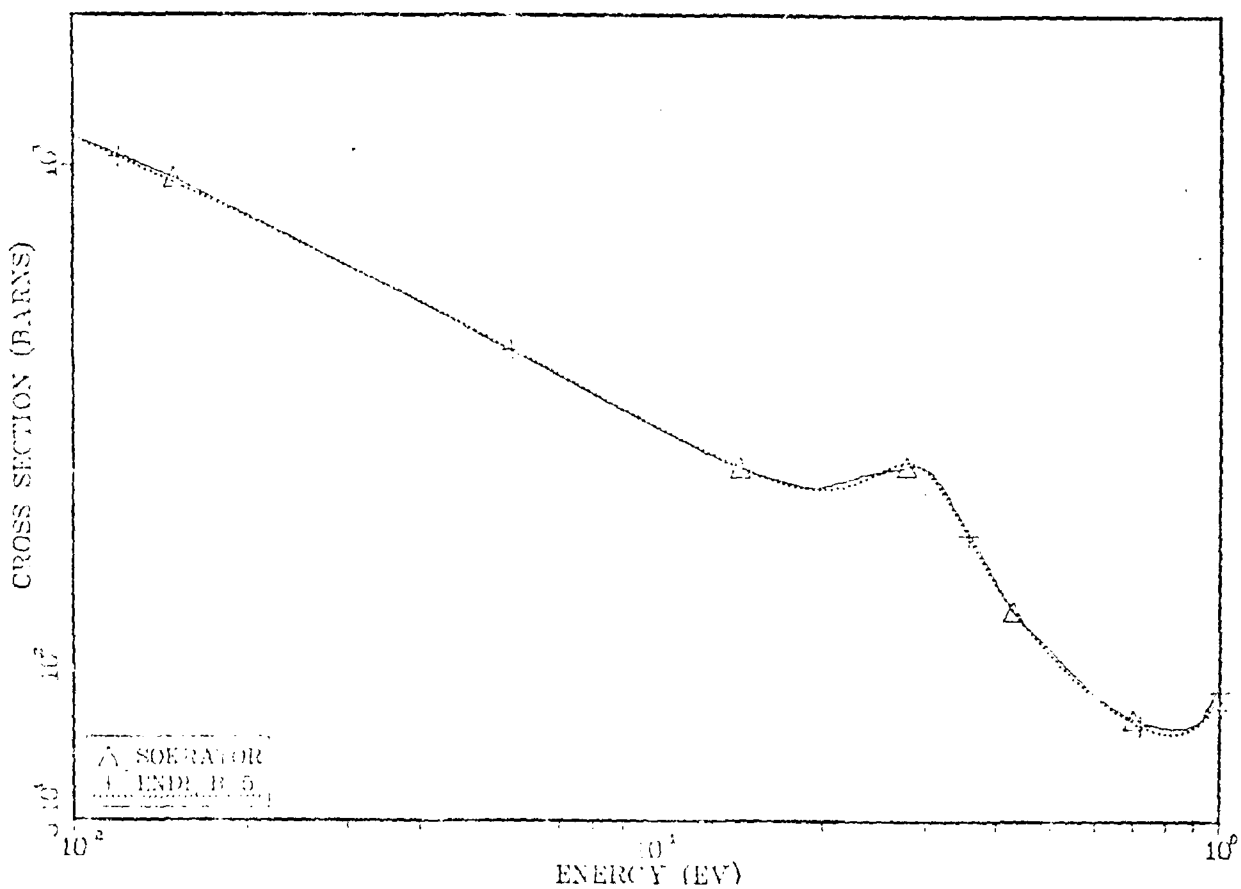

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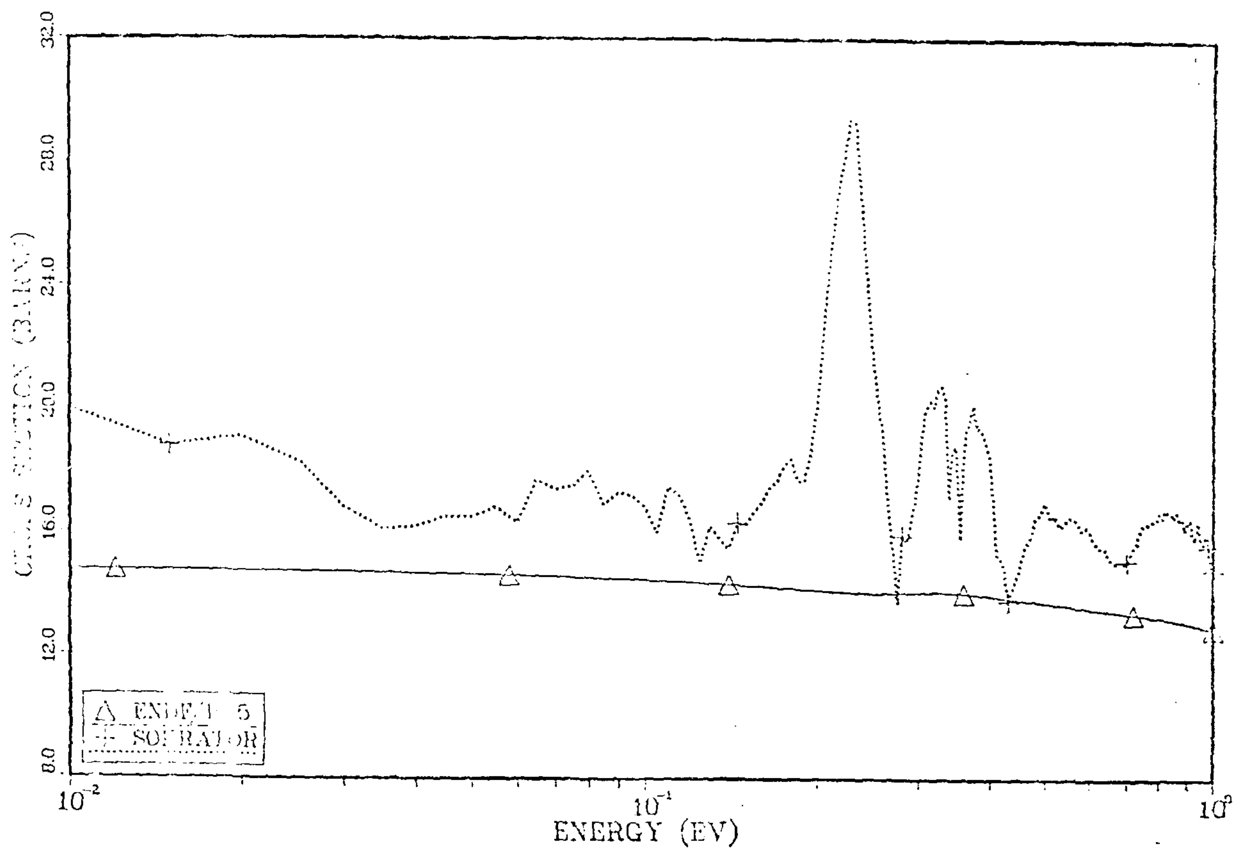

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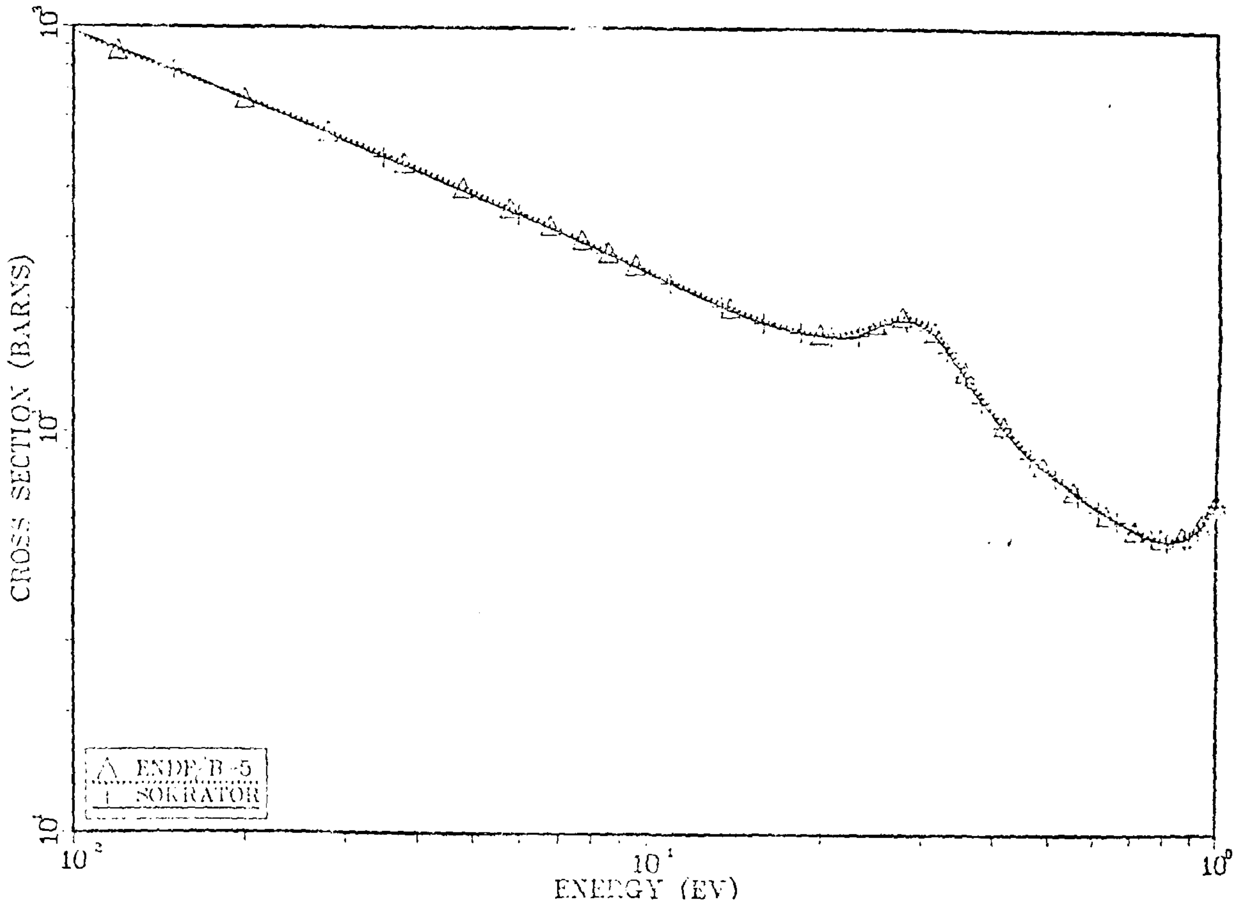

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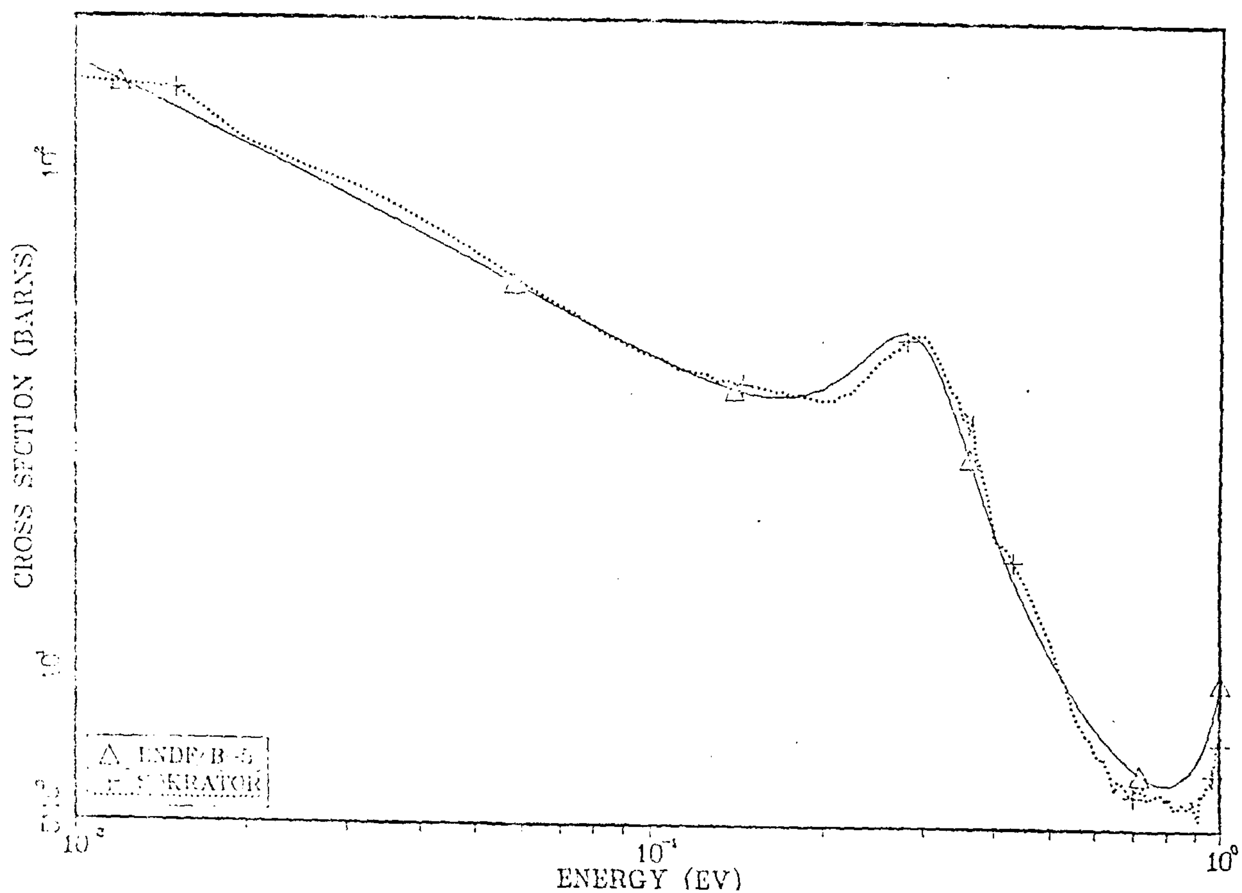

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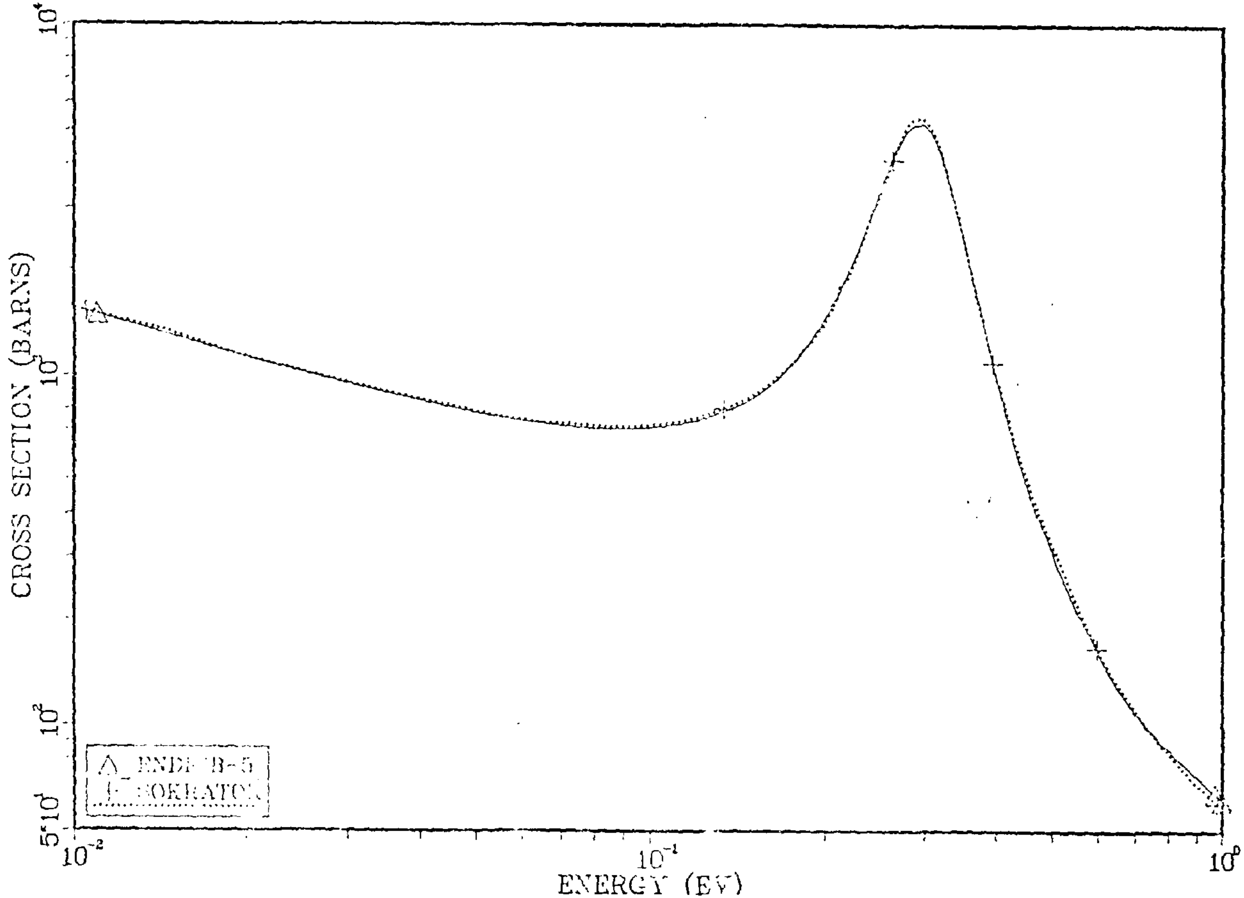

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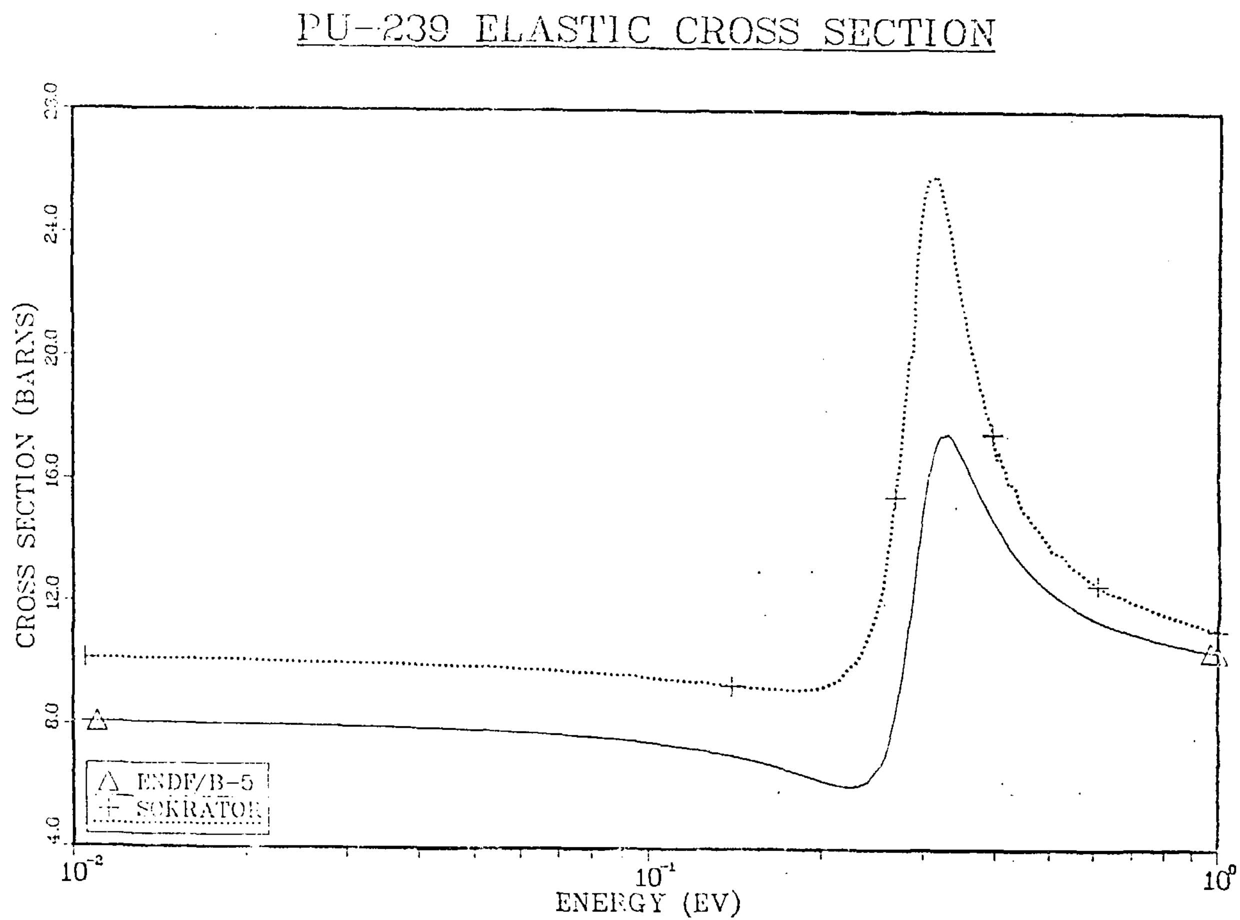

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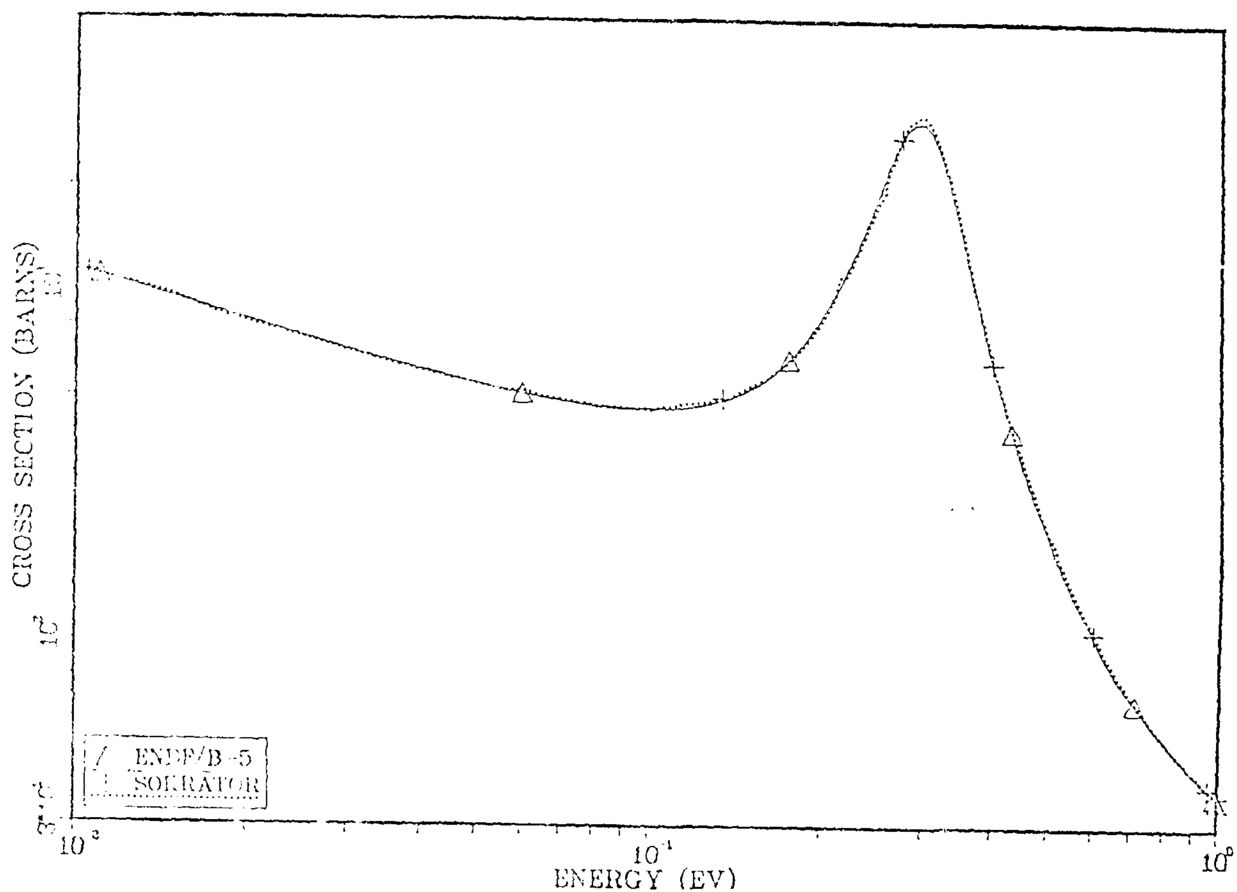

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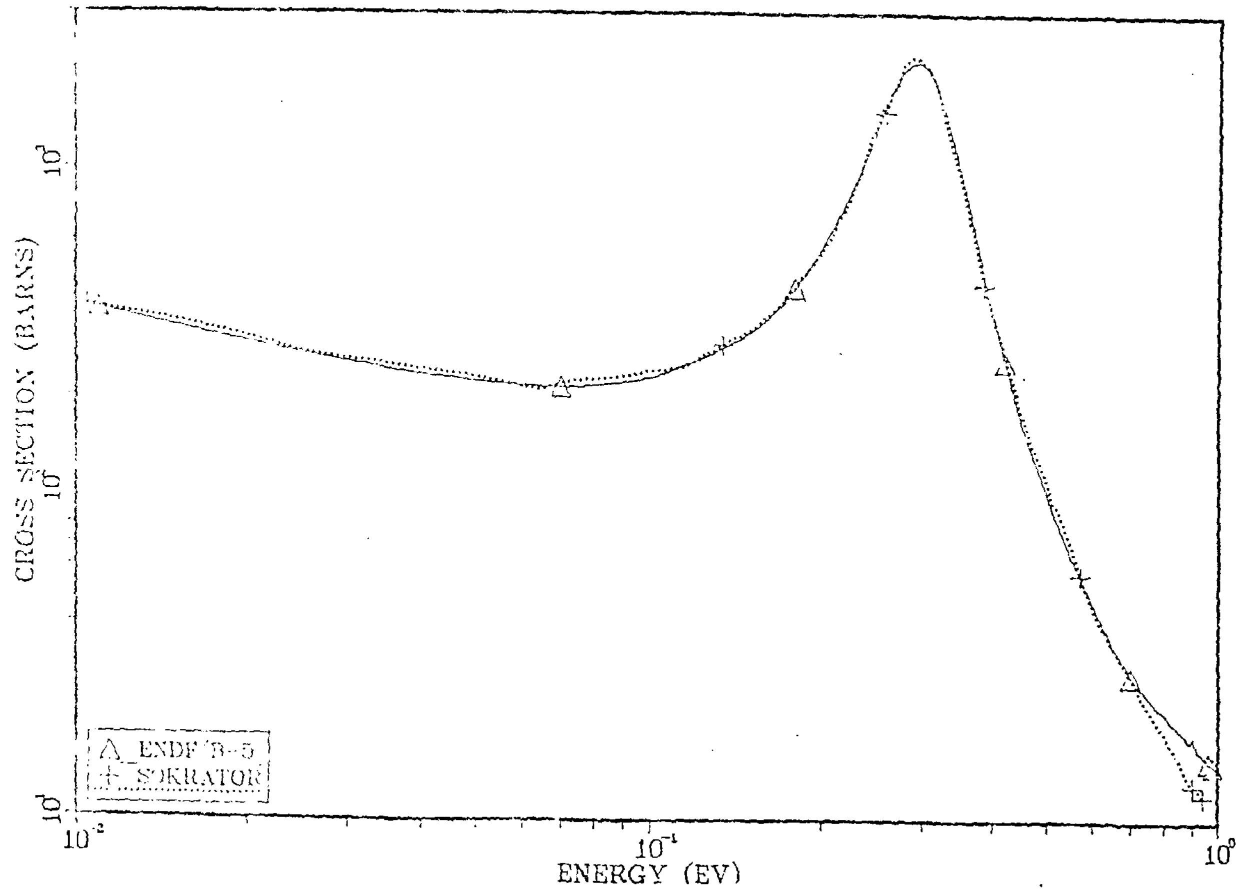

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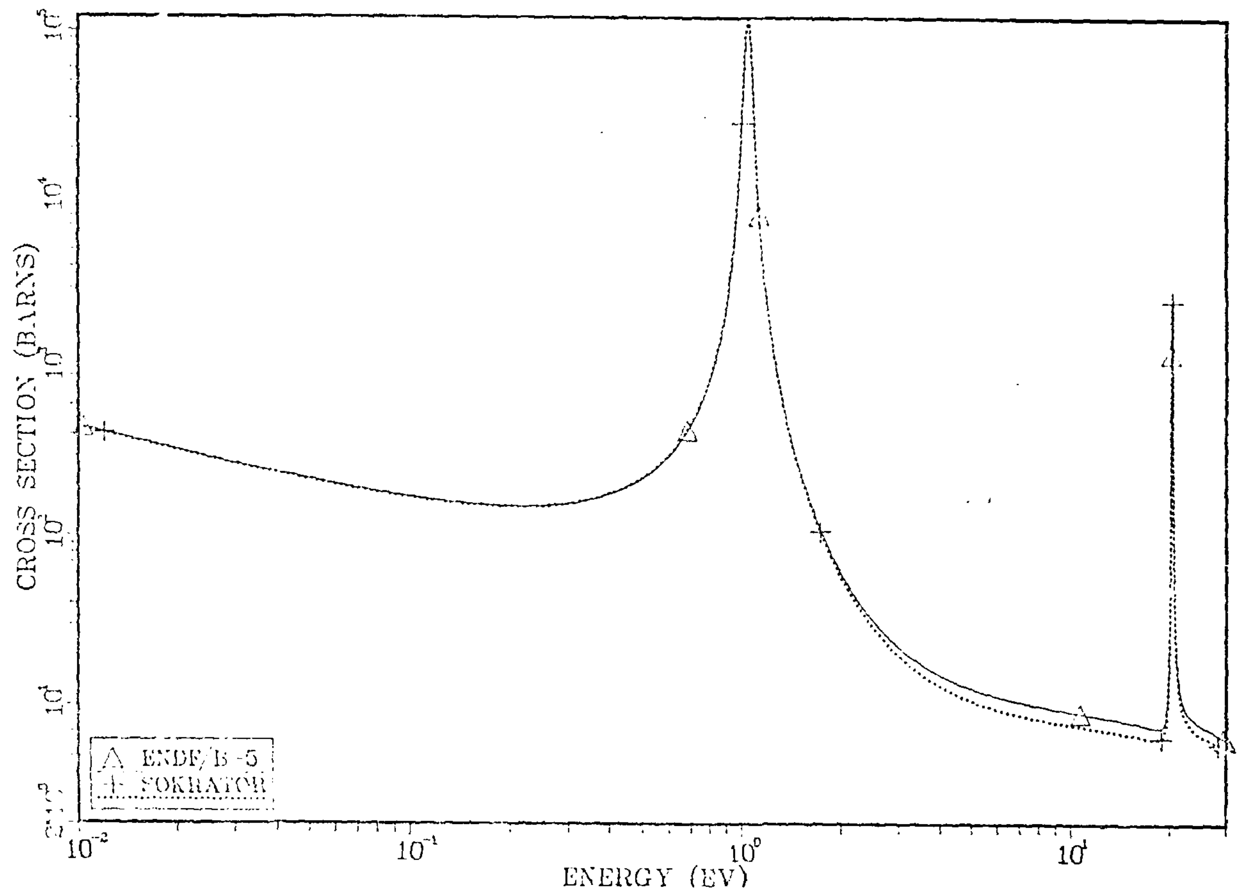

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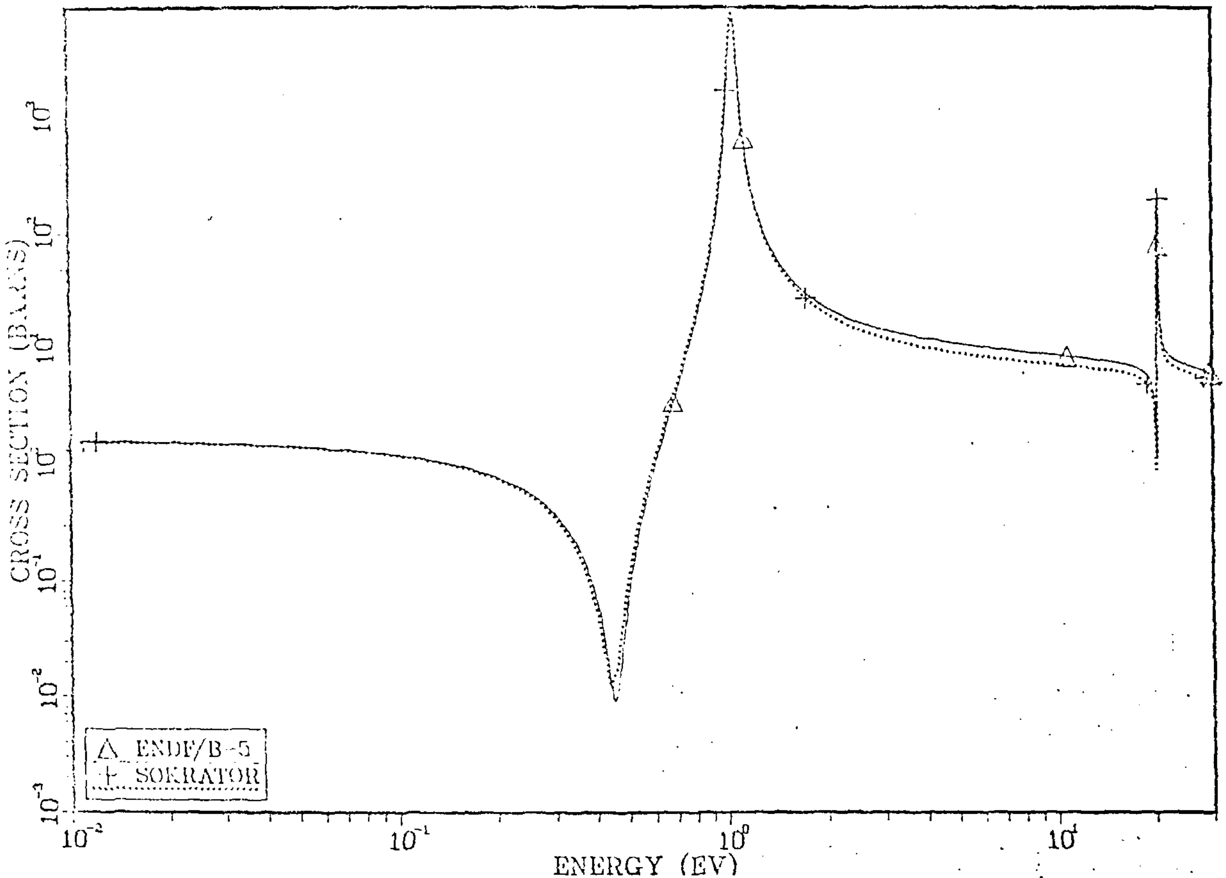

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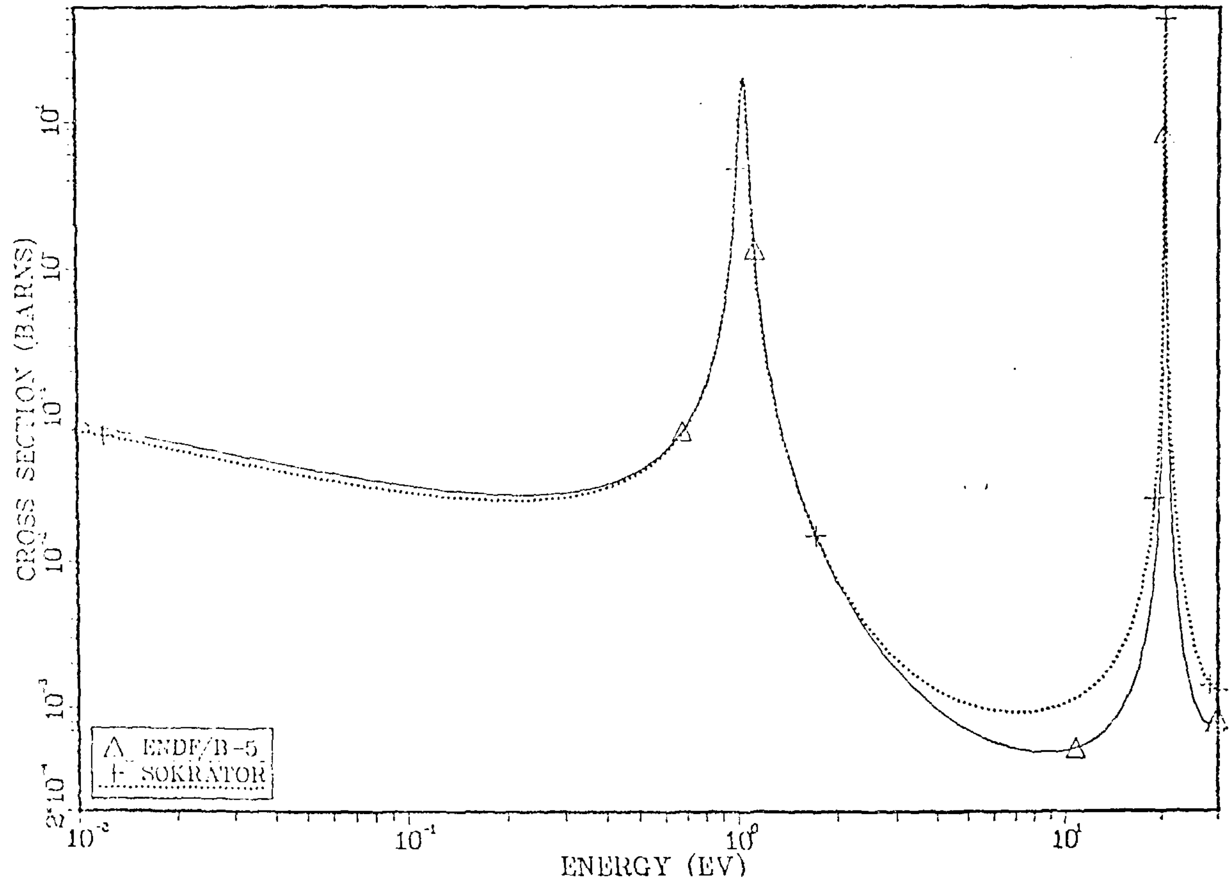

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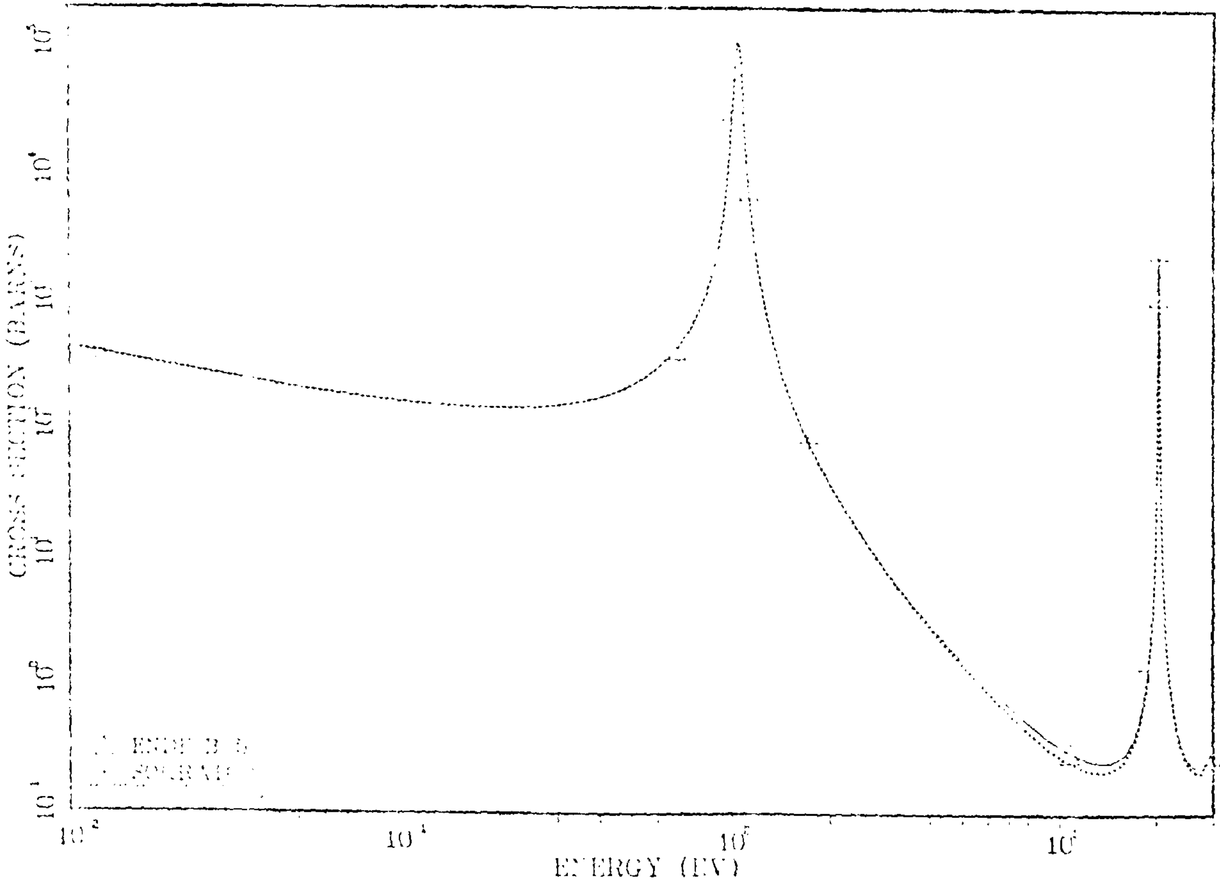

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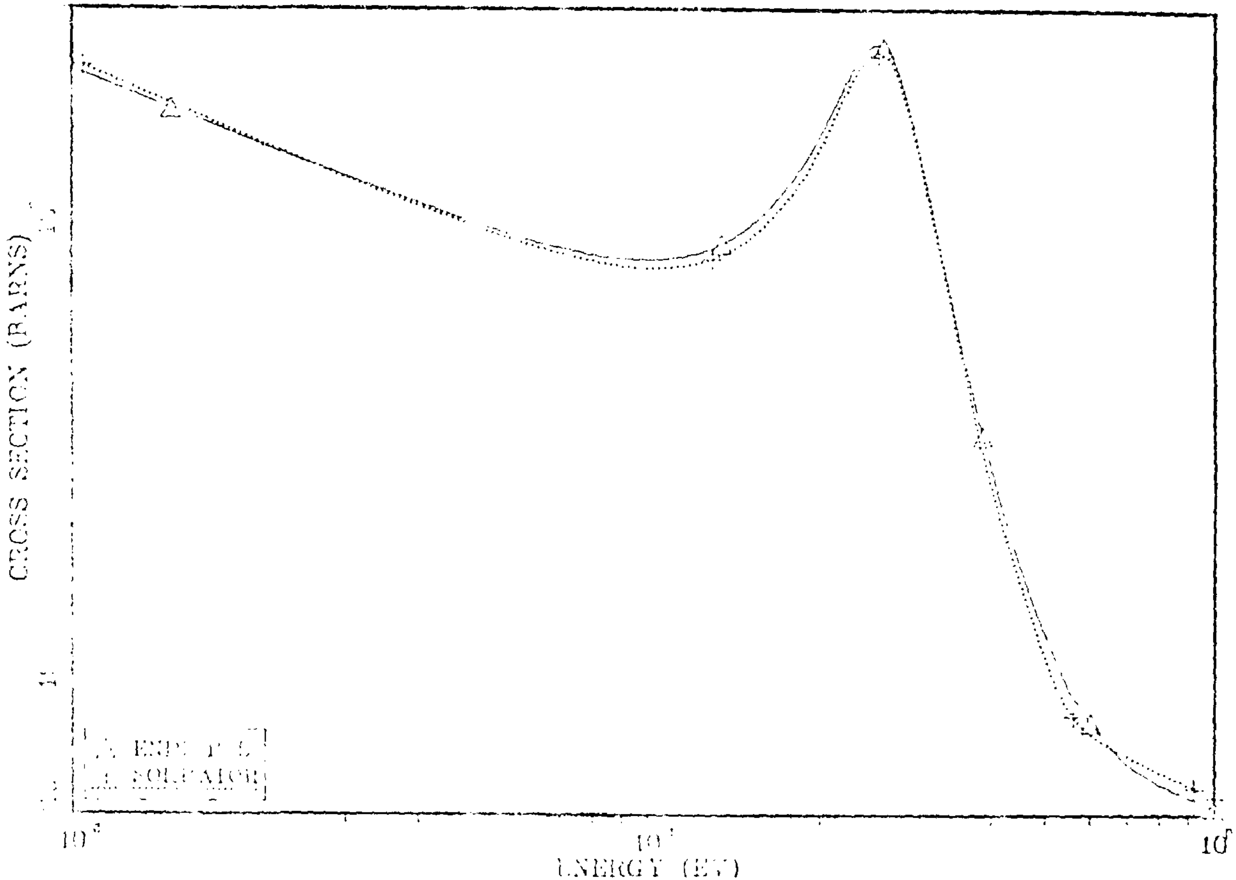

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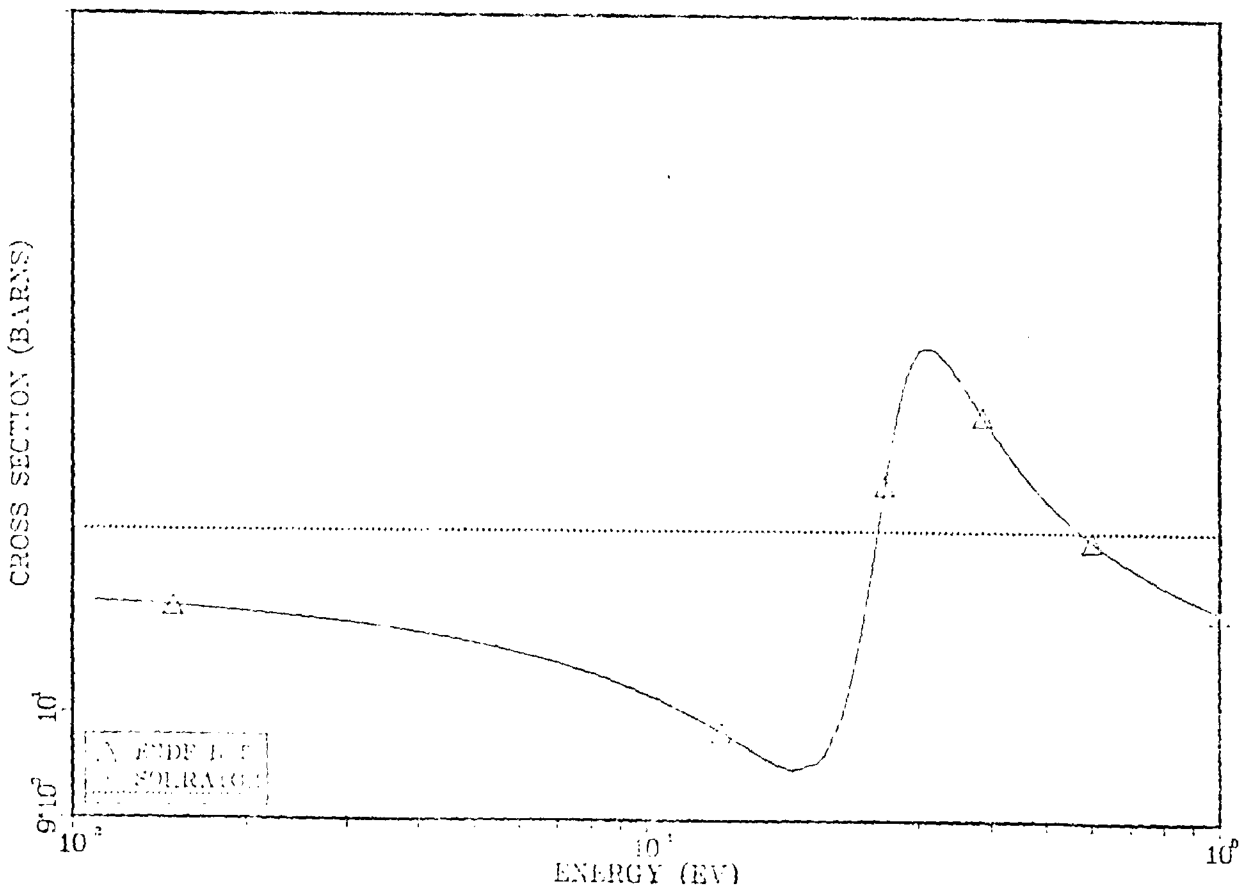

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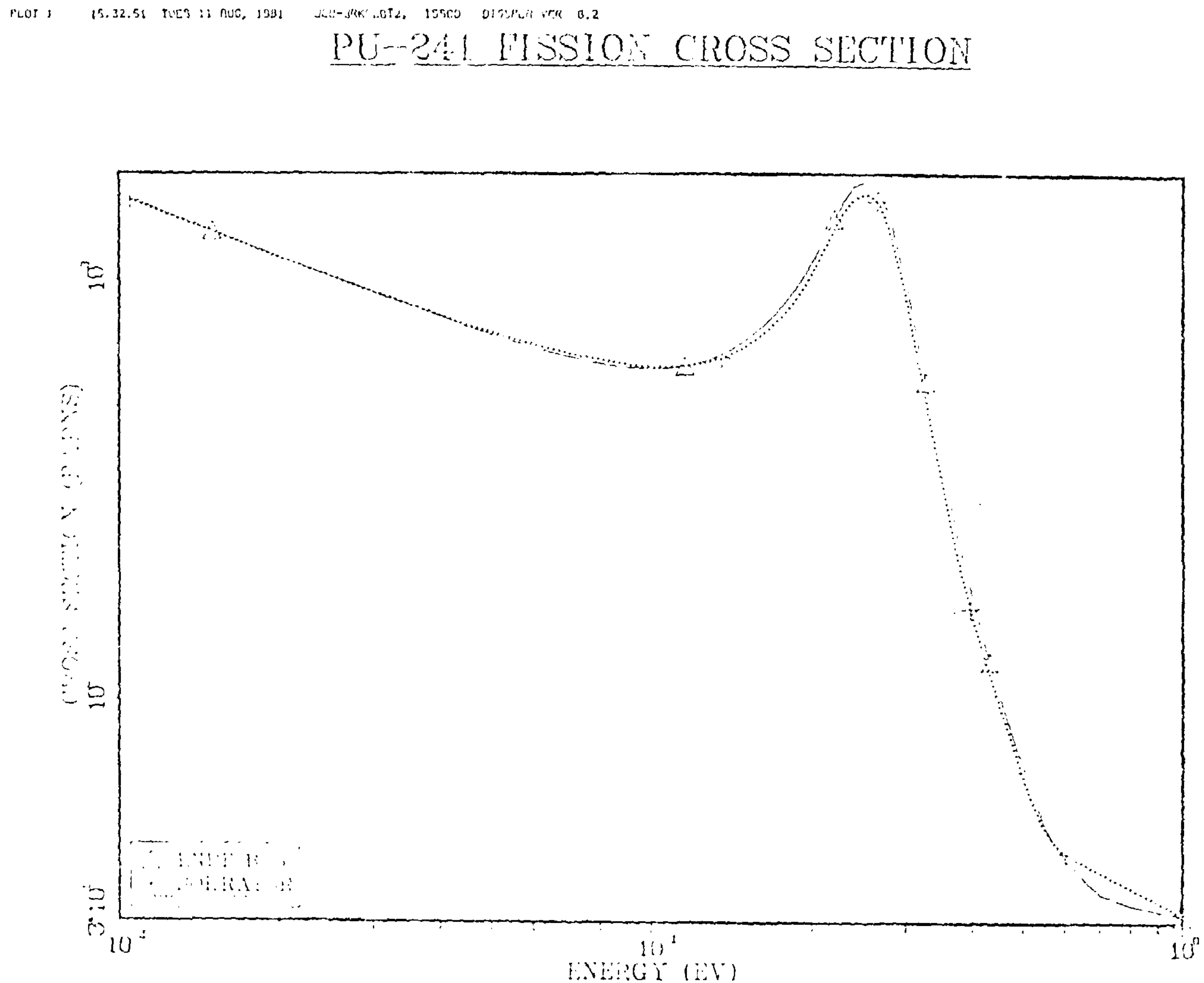

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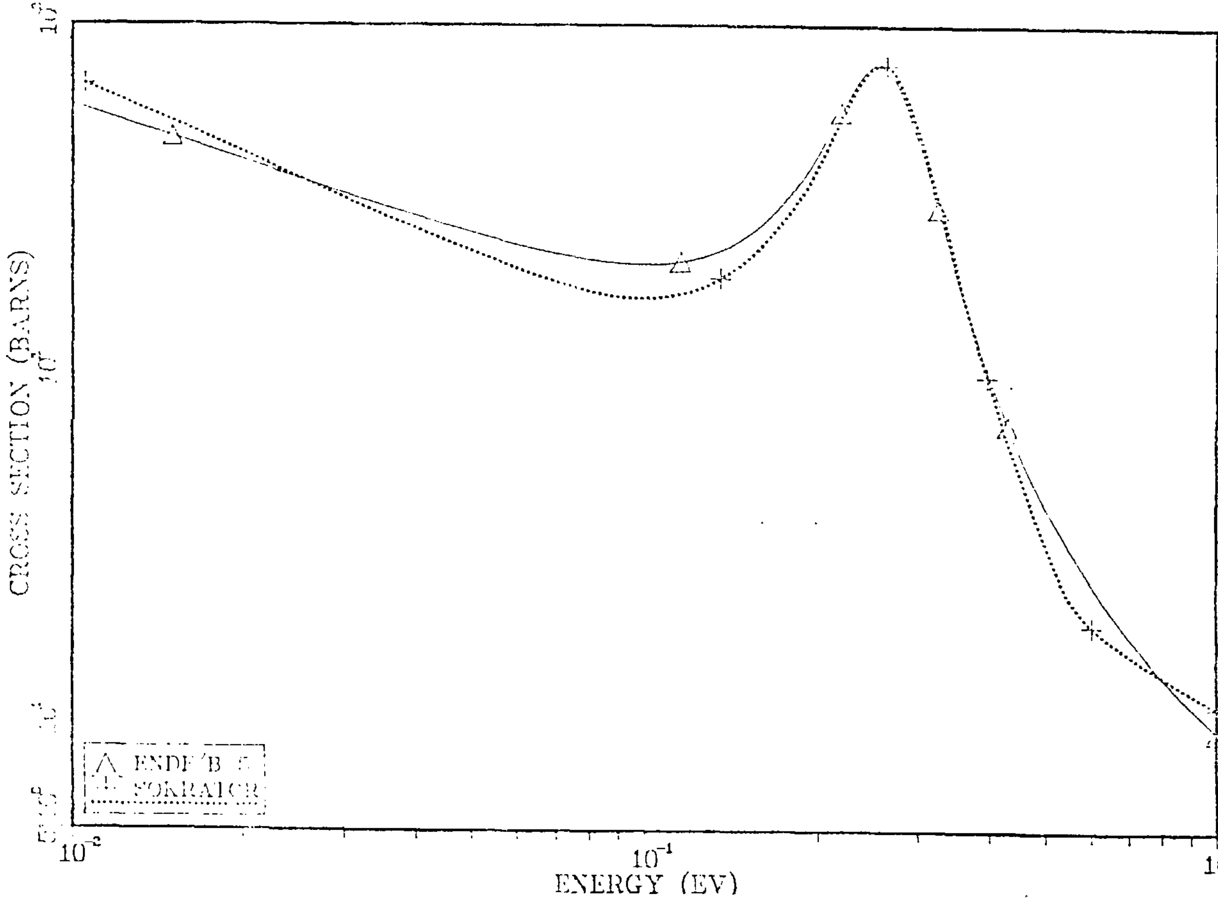
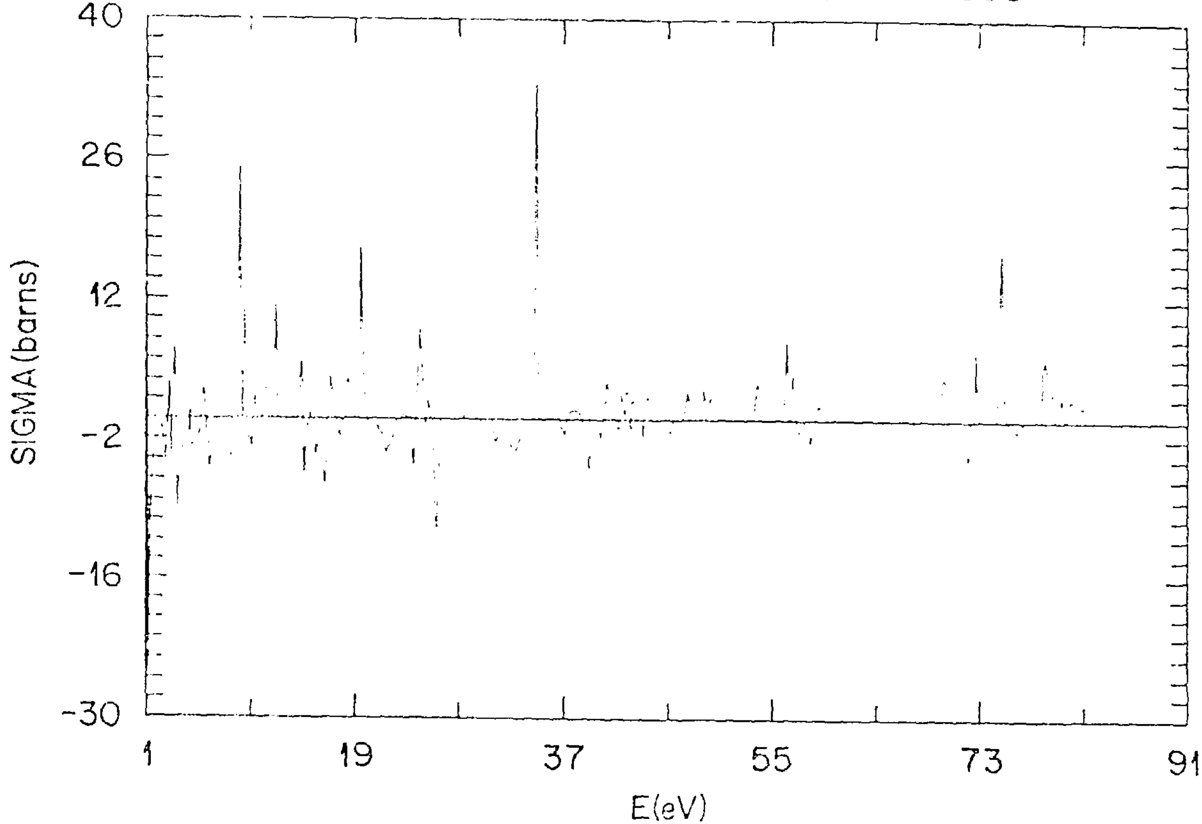
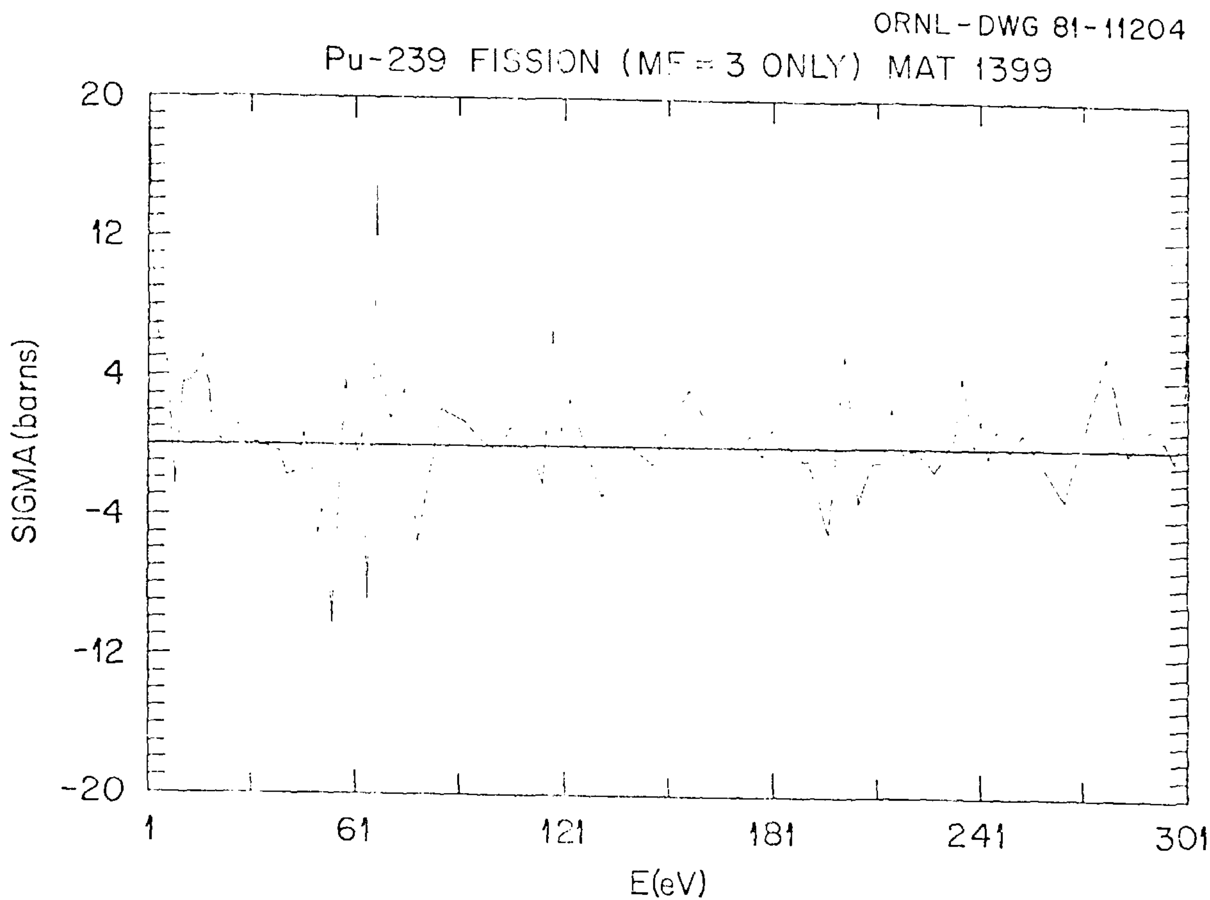


ORNL-DWG 81-11208

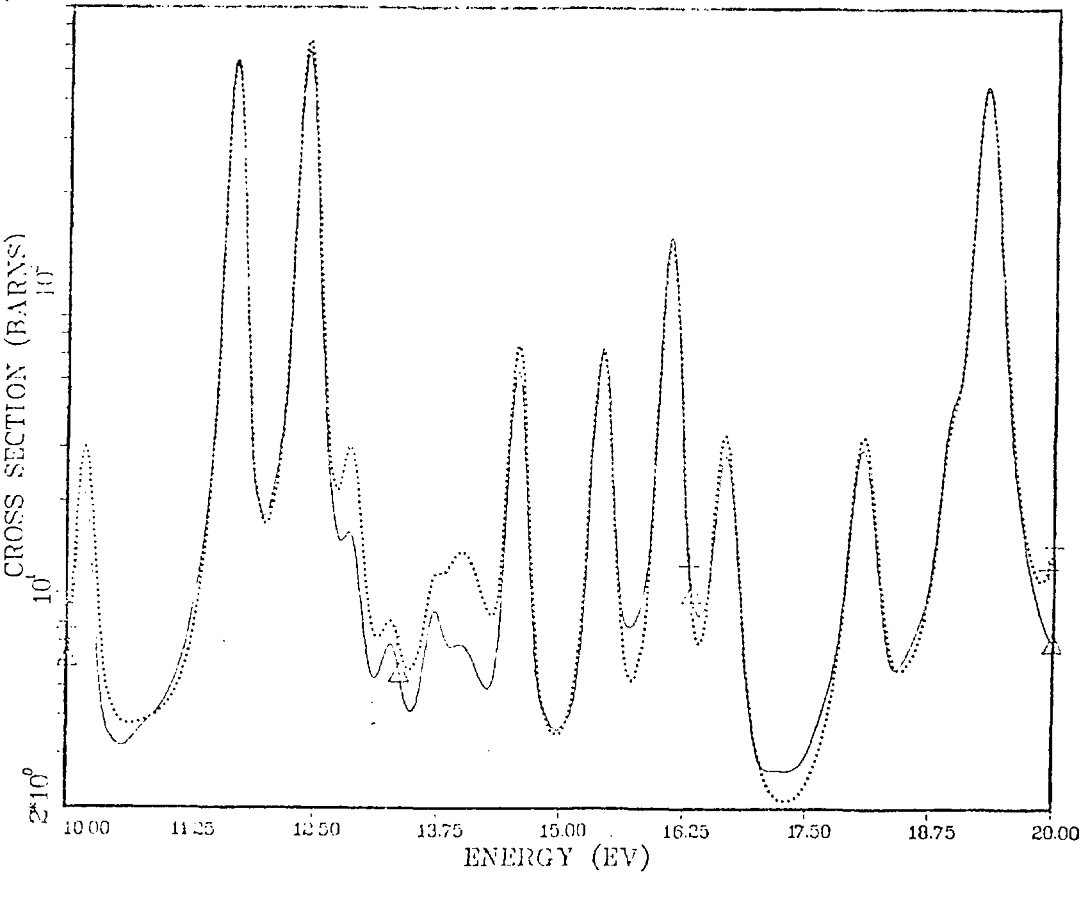
U-235 FISSION (MF = 3 ONLY) MAT 1395




ORNL-DWG 81-11204
Pu-239 FISSION (MF = 3 ONLY) MAT 1399
SIGMA (barns)
20
12
4
-4
-12
-20
1
61
121
181
241
301
E(eV)

ORNL-DWG 81-18122

U-235 CAPTURE CROSS SECTION



PLOT 1 10.45.48 THUR 3 SEP, 1981 JOB-COMPLOT2, ISSCO DISSPLA VER 8.2

U-235 FISSION CROSS SECTION

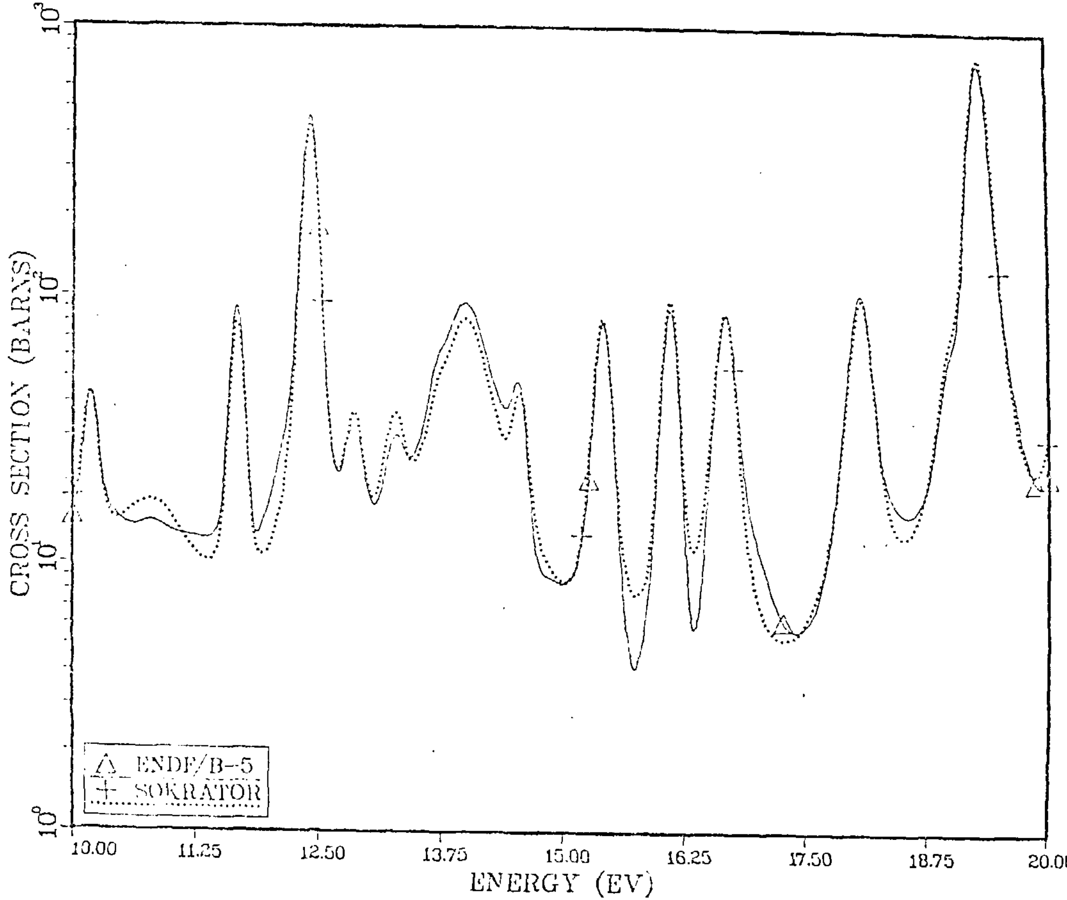
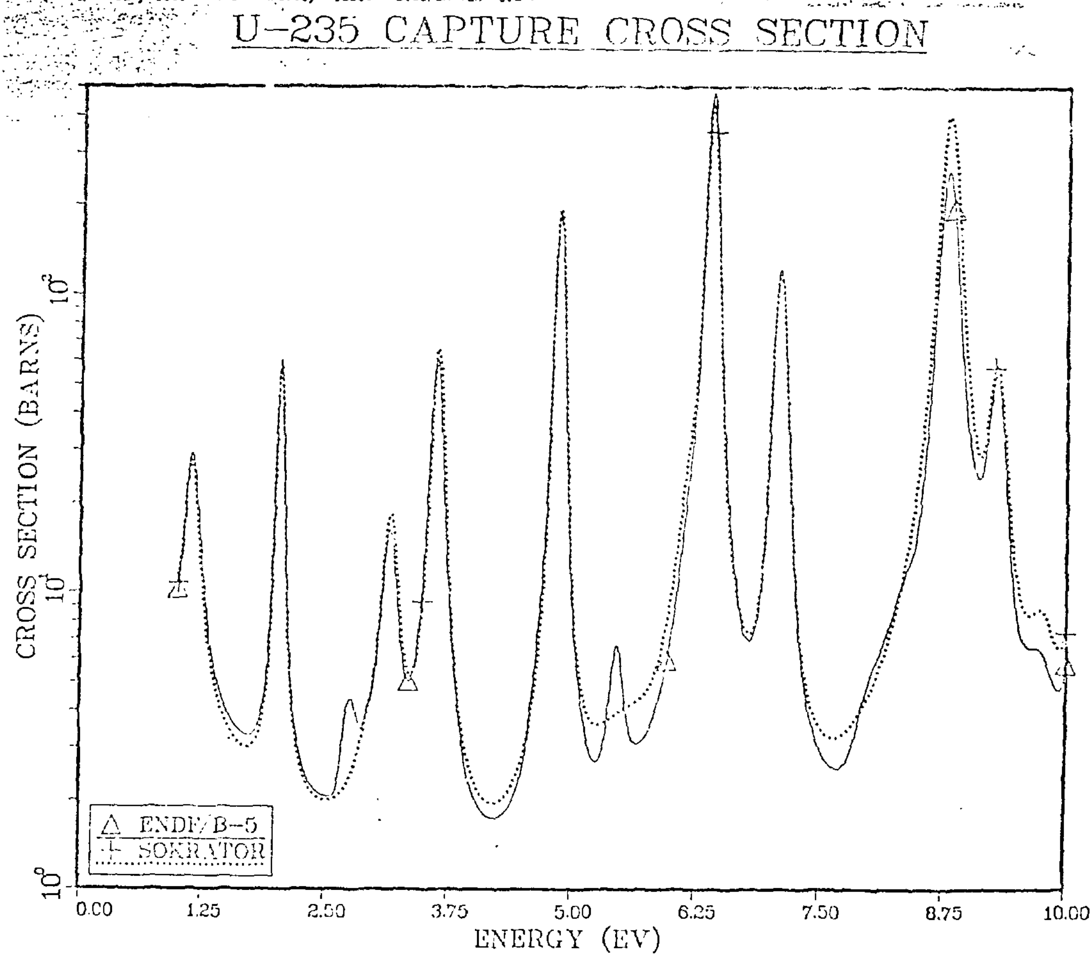


Fig 91

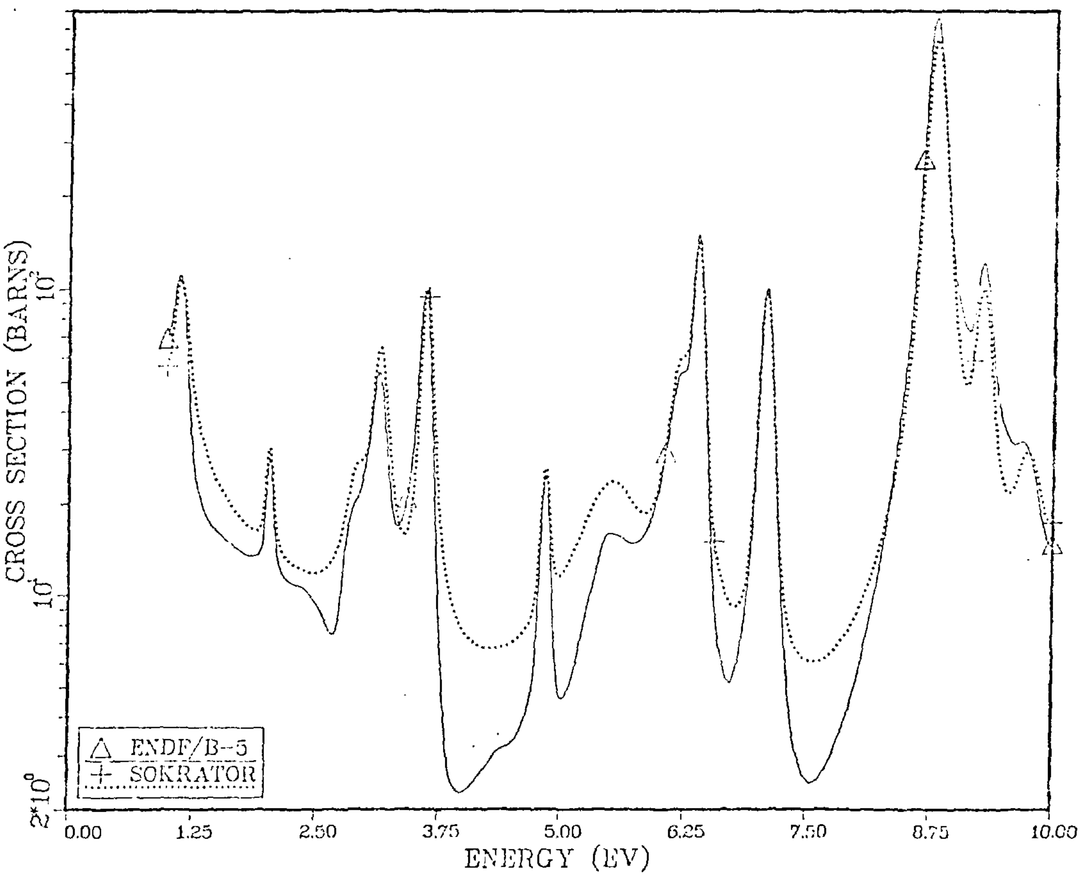
4.56 FRI 6 SEP, 1991 JOB-RCHPLOT1, ISSCO DISSPLA VER 8.2 ORNL-DWG 81-18124



ORNL-DWG 81-18125

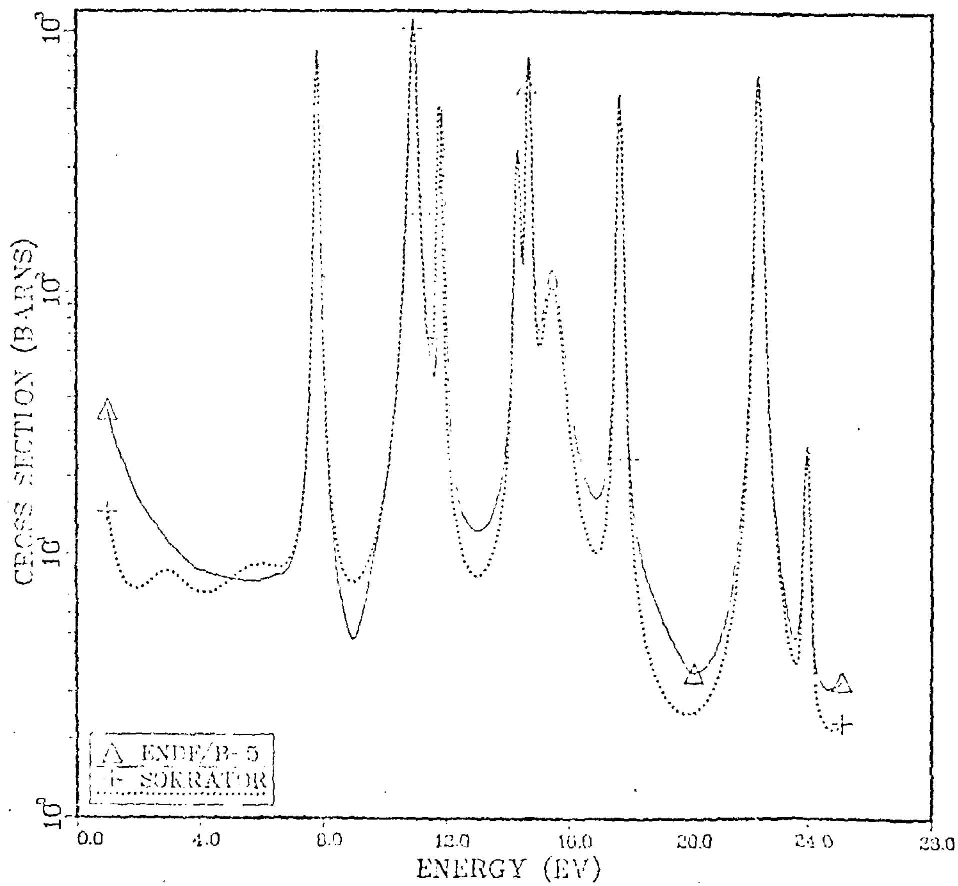
24.05 WED 2 SEP, 1981 JOB-RONPLOT1, ISSCO DISSPLA VER 8.2

U-235 FISSION CROSS SECTION



PLOT 2 12.52.45 THUR 3 SEP, 1981 JOB=RONPLOT3, ISSCO DISSPLA VER 8.2

PU-239 FISSION CROSS SECTION



PU-239 CAPTURE CROSS SECTION

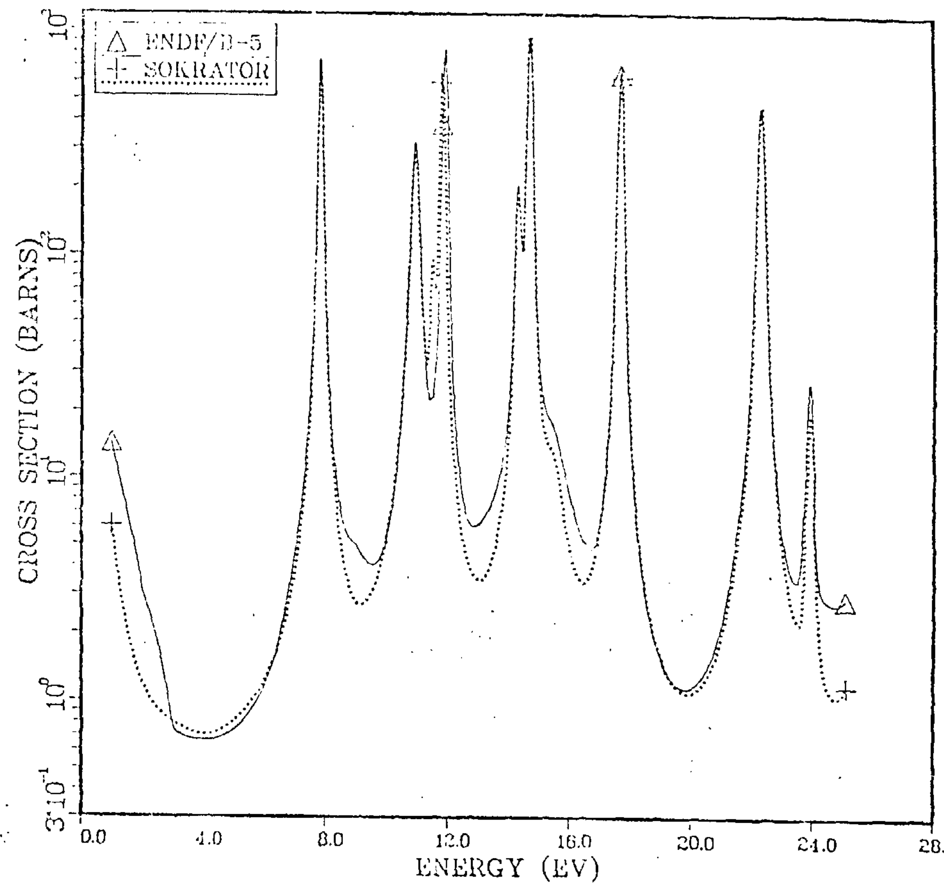


Fig 9.4

FIGURE CAPTIONS

Fig. 1. Comparison of the ENDF/B-V and SOKRATOR Evaluations of the ^{235}U total cross sections below 1.0 eV.

Fig. 2. ^{235}U scattering.

Fig. 3. ^{235}U fission.

Fig. 4. ^{235}U capture.

Fig. 5. ^{239}Pu total.

Fig. 6. ^{239}Pu scattering.

Fig. 7. ^{239}Pu fission.

Fig. 8. ^{239}Pu capture.

Fig. 9. ^{240}Pu total.

Fig. 10. ^{240}Pu scattering.

Fig. 11. ^{240}Pu fission.

Fig. 12. ^{240}Pu capture.

Fig. 13. ^{241}Pu total.

Fig. 14. ^{241}Pu scattering.

Fig. 15. ^{241}Pu fission.

Fig. 16. ^{241}Pu capture.

Fig. 17. The "smooth" contribution (MF=3) to the ENDF/B-V ^{235}U fission cross section in the resolved resonance range. This contribution must be added to the Breit-Wigner resonance contribution (MF=2) to obtain the evaluated fission cross section.

Fig. 18. The "smooth" contribution (MF=3) to the ENDF/B-V ^{239}Pu fission cross section in the resolved resonance range. This contribution must be added to the Breit-Wigner resonance contribution (MF=2) to obtain the evaluated fission cross section.

Fig. 19. Comparison of the ENDF/B-V and SOKRATOR evaluations of the ^{235}U fission cross section from 1.0 to 10.0 eV.

Fig. 20. Comparison of the ENDF/B-V and SOKRATOR evaluations of the ^{235}U capture cross section from 1.0 to 10.0 eV.

•Fig. 21. Comparison of the ENDF/B-V and SOKRATOR evaluations of the ^{235}U fission cross section from 10.0 to 20.0 eV.

Fig. 22. Comparison of the ENDF/B-V and SOKRATOR evaluations of the ^{238}U capture cross section from 1.0 to 10.0 eV.

Fig. 23. Comparison of the ENDF/B-V and SOKRATOR evaluations of the ^{239}Pu fission cross section from 1.0 to 25.0 eV.

Fig. 24. Comparison of the ENDF/B-V and SOKRATOR evaluations of the ^{239}Pu capture cross section from 1.0 to 25.0 eV.

Table I. Comparison of the ENDF/B-V and SOKRATOR ^{235}U Evaluations

File Structure	ENDF/B-V	SOKRATOR
MAT Number ([illegible])	1395	9210
AWRI (Target Mass/Neutron Mass)	[illegible]	233.0
AP: Scattering Radius (10^{-12} cm)	0.95663	0.8391
Resolved Range (eV)	1 - 82	1 - 100
LRF, Formalism Employed	1, SLBW	2, MLBW[a]
Number of Levels	130	208
[illegible]	[illegible]	[illegible]
Range for MF=3 ≠ 0.0 (eV)	$10^{-[illegible]}$ - 2×10^{7}	$10^{-[illegible]}$ - 1.0 100 - 1.5×10^{7}

[a]Modified Adler-Adler parameters also available.

Table II. Comparison of the ENDF/B-V and SOKRATOR [illegible] Evaluations

File Structure	ENDF/B-V	SOKRATOR
MAT Number ([illegible])	1339	942[illegible]
AWRI: (Target Mass)/(Neutron Mass)	237.0	237.0
AP: Scattering Radius (10^{-12} cm)	.90094	.905
Resolved Range (eV)	1 - 301	1 - 500
LRF, Formalism Employed	1, SLBW	2, MLBW
Number of Levels	122	[illegible]
Unresolved Range (eV)	301 - 25000	No URR
Range for MF=3 ≠ 0.0 (eV)	10^{-5} - 2.10^{7}	10^{-4} - 1. 500. - $1.5.10^{7}$

Table III. Comparison of the ENDF/B-V and SOKRATOR ^{238}Pu Evaluations

File Structure	ENDF/B-V	SOKRATOR
MAT Number ([illegible] Pu)	1380	9430
AWRI: (Target Mass)/(Neutron Mass)	237.992	238.0
AP: Scattering Radius (10^{-12} cm)	.918[illegible]	.8578
Resolved Range (eV)	10^{-5} - 3910	1 - 1000.
LRF, Formalism Employed	2, MLBW	2, MLBW
[illegible]	[illegible]	[illegible]
Unresolved Range (eV)	3910 - 40000	1000 - 150000
Range for MF=3 ≠ 0.0 (eV)		10^{-3} - 1.0
	200 - 2.10^7	4318 - $1.5.10^7$

Table IV. Comparison of the ENDF/B-V and SOKRATOR ^{241}Pu Evaluations

File Structure	ENDF/B-V	SOKRATOR
MAT Number (^{241}Pu)	1381	2024
AWRI: (Target Mass)/(Neutron Mass)	238.978	238.986
AP: Scattering Radius (10^{-12} cm)	.933	.845
Resolved Range (eV)	2.873 - 100.	1. - 100.
LRF, Formalism Employed	4, Adler	4, Modif. Adler
Number of Levels	83	112
Unresolved Range (eV)	100. - 40200	100. - 10^5
Range for MF=3 ≠ 0.0 (eV)	10^{-5} - 2.873	10^{-4} - 1.0
	4020 - $2.0.10^7$	$1.0.10^5$ - $1.5.10^7$

Table V. Comparison of the ENDF/B-V and SOKRATOR ^{235}U Evaluations

Thermal Region		ENDF/B-V	SOKRATOR
MAT Number (^{235}U)		1395	9210
Energy Range Below Resolved Range (eV)		10^{-5} - 1.	10^{-4} - 1
Temperature (K)		0	293
Number of (E, σ) - points		219	149
INT, Interpolation		5. Log-Log	2, Lin-Lin
Cross Sections at .0253 eV (b)			
MT=1	Total	696.603	697.5
MT=2	Scattering	14.713	18.3
MT=18	Fission	583.54±1.7	577.7
MT=102	Capture	98.38±.76	101.5
Westcott g-factors at 293 K			
MT=1		.9811	.9818
MT=2		1.1220	1.0636
MT=18		.9775	.9807
MT=102		.9823	.9716

Table VI. Comparison of the ENDF/B-V and SOKRATOR ^{239}Pu Evaluations

Thermal Region	ENDF/B-V	SOKRATOR
MAT Number (^{239}Pu)	1399	9420
Energy Range Below Resolved Range (eV)	10^{-5} - 1.	10^{-4} - 1.
Temperature (K)	0	293
Number of (E, σ) points	219	143
INT, Interpolation	Lin-Lin	Lin-Lin
Cross Sections at .0253 eV (b).		
MT=1 Total	1019.9	[illegible]
MT=2 Scattering	8.002	10.036
MT=18 Fission	741.7	740.4
MT=102 Capture	270.2	274.1
Westcott g-factors at 293 K		
MT=1	1.0755	1.0730
MT=2	1.1025	1.1123
MT=18	1.0548	1.0545
MT=102	1.1307	1.1402

Table VII. Comparison of the ENDF/B-V and SOKRATOR ^{240}Pu Evaluations

Thermal Region		ENDF/B-V	SOKRATOR
MAT Number (^{240}Pu)		1380	9430
Energy Range Below Resolved Range (eV)		No L.E.R.	10^{-3} - 1
Temperature (K)			293
Number of (E, σ) points			95
INT, Interpolation			2, Lin-Lin
Cross Sections at .0253 eV (b)			
MT=1	Total	292.04	289.32
MT=2	Scattering	1.555	1.540
MT=18	Fission	.0572	.0508
MT=102	Capture	290.43	287.73
Westcott g-factors at 293 K			
MT=1		1.0269	1.0165
MT=2		1.0469	1.0461
MT=18		1.0245	1.0264
MT=102		1.0263	1.0164

Table VIII. Comparison of the ENDF/B-V and SOKRATOR ^{241}Pu Evaluations

Thermal Region	ENDF/B-V	SOKRATOR
MAT Number (^{241}Pu)	1381	2024
Energy Range Below Resolved Range (eV)	10^{-5} - 2.873	10^{-4} - 1.0
Temperature (K)	0	293
Number of (E, σ) points	121	140
INT, Interpolation	5, Log-Log and 2	2 Lin-Lin
Cross Sections at .0253 eV (b)		
MT=1 Total	1387.0	1390.0
MT=2 Scattering	11.0	12.0
MT=18 Fission	1015.0	1015.0
MT=102 Capture	361.4	363.0
Westcott g-factors at 293 K		
MT=1	1.0445	1.0417
MT=2	1.1044	1.1284
MT=18	1.0459	1.0465
MT=102	1.0378	1.0296

Table IX. The 2200 m/s Fission and Capture Cross Sections and the Value of ν_T for ^{235}U, ^{239}Pu, and ^{241}Pu

		ENDF/B-V	SOKRATOR	IAEA-69[a]	IAEA-75[b]	Leonard-76/81[c]
^{235}U	σ_{nf}	583.54±1.7	577.7	580.2±1.8	583.5±1.3	583.54±1.7
	$\sigma_{n\gamma}$	98.38±.76	101.5	98.3±1.1	97.4±1.6	98.38±.76
	g_f	.9775	.9807	.9766±.0016	.976±.002	.9775±.0011
	g_γ	.9823	.9716	.991	1.003±.018	.9823±.0014
	ν_T	2.437	2.408	2.423±.007	2.416±.005	
^{239}Pu	σ_{nf}	741.7	740.4	741.6±3.1	744.0±2.5	754.84±4.5
	$\sigma_{n\gamma}$	270.2	274.1	271.3±2.6	267.2±3.3	273.75±2.7
	g_f	1.0548	1.0545	1.0548±.0030	1.0555±.0024	1.05353±.0015
	g_γ	1.1307	1.1402	1.131	1.151 ±.015	1.13872±.011
	ν_T	2.891	2.880	2.880 ±.009	2.862 ±.008	
^{241}Pu	σ_{nf}	1015.0	1015.0	1007.3±7.2	1015±7	1003.8
	$\sigma_{n\gamma}$	361.4	363.0	368.1±7.8	362±6	364.66
	g_f	1.0459	1.0465	1.0486±.0053	1.0442±.0048	
	g_γ	1.0378	1.0296	1.008	1.025 ±.016	
	ν_T	2.953	2.924	2.934 ±.012	2.924 ±.010	

[a] G. C. Hanna *et al.* Atomic Energ. Rev. 7, 4, 3 (1969).

[b] H. D. Lemmel, Conf. Nuclear Cross Sections and Technology, Washington, D. C., I, 286, 1975.

[c] B. R. Leonard *et al.* EPRI-NP-167 (1976) and EPRI-NP-1763 (1981).

Table X. Comparison of the ENDF/B-V and SOKRATOR ^{235}U Evaluations

3. Resonance parameters below 20 eV.

E_0(eV)	$2g\,\Gamma_n$ (meV)		Γ_f (meV)		Γ_γ (meV)		J
(approximate)	ENDF	SOKRATOR	ENDF	SOKRATOR	ENDF	SOKRATOR	SOKRATOR
-1.49	3.682	3.677	207.0	212.25	27.0	22.256	4
.29	.00302	.00302	99.0	100.74	36.0	34.26	3
1.14	.01516	.01397	116.2	115.25	34.6	35.55	4
2.04	.00739	.00739	98.14	101.64	34.9	34.52	3
2.92	.00485	.00729	200.0	209.12	20.0	10.87	4
3.15	.0224	.0265	106.37	107.00	33.2	32.56	3
3.61	.0456	.0468	50.637	49.504	33.7	34.83	4
4.85	.0604	.0613	3.587	3.245	35.9	36.29	4
5.5	.0034		30.117		60.0		
5.6	.0333	.0639	621.89	671.78	20.0	59.27	4
6.21	.0638	.0604	187.36	165.62	43.5	65.19	3
6.38	.263	.247	9.548	9.569	35.0	35.0	4
7.08	.127	.123	28.233	28.238	35.6	35.6	4
8.78	1.123	1.157	91.0	75.4	31.2	46.9	4
9.28	.164	.145	75.0	69.3	35.6	41.6	4
9.75	.0530	.0534	237.0	211.8	32.0	47.2	3
10.2	.0619	.0687	62.5	54.7	38.0	45.8	4
10.8	.0933	.1137	868.0	856.1	67.0	69.9	4
11.7	.627	.617	6.25	5.52	40.4	41.2	4
12.4	1.262	1.296	27.5	25.285	34.5	36.5	3
12.9	.0531	.0913	86.0	60.97	33.5	55.5	4
13.3	.0393	.0552	122.8	131.79	28.6	19.6	4
13.7	.0370	.0259	93.5	86.28	30.4	37.6	3
14.0	.537	.508	470.0	431.6	26.0	64.3	3
14.6	.115	.126	20.9	17.4	35.2	38.7	3
15.4	.237	.247	43.3	48.5	35.3	36.3	4
16.1	.361	.375	18.617	22.5	31.4	33.2	4
16.7	.237	.270	100.89	87.4	32.1	32.3	4
18.1	.385	.371	125.0	116.6	35.0	37.9	3
19.0	.116	.116	55.0	62.0	50.0	37.9	4
19.3	3.194	3.388	60.179	66.102	34.8	35.9	4

Table XI. Comparison of the ENDF/B-V and SOKRATOR ^{239}Pu Evaluations

3. Resonance Parameters Below 25 eV

E_0(eV)	J		$2g\Gamma_n$(meV)		Γ_f(meV)		Γ_γ(meV)	
	ENDF	SOK	ENDF	SOKRATOR	ENDF	SOKRATOR	ENDF	SOKRATOR
-.22	0		.0235		500.		40.0	
.296	0	0	.121	.123	60.	61.2	39.0	37.4
3.0		1/2		.020		1052.		[illegible]
5.9		1/2		.094		3259.		43.3
7.8	1	1	1.228	1.147	45.8	48.2	40.2	38.8
10.9	1	1	2.799	2.648	153.1	156.6	44.2	42.2
11.5		1/2		.085		10.4		41.2
11.8	1	1	1.521	1.339	24.4	29.0	40.6	37.0
14.3	1	1	.893	.964	65.1	67.0	35.9	34.0
14.7	1	1	2.685	2.839	30.2	20.2	36.8	38.8
15.5	0	0	1.060	.934	[illegible]	648.9	39.0	50.0
17.7	1	1	2.538	2.450	33.5	32.4	38.5	40.6
22.3	1	1	[illegible]	2.714	69.4	[illegible]	46.7	44.2
23.9	0	1	.136	.128	32.6	40.0	37.4	30.0

Table XII. Comparison of the ENDF/B-V and SOKRATOR ^{240}Pu Evaluations

3. Resonance Parameters Below 100 eV

E(eV)	$g\Gamma_n$(meV)		Γ_f(meV)		Γ_γ(meV)	
	ENDF	SOKRATOR	ENDF	SOKRATOR	ENDF	SOKRATOR
-14.45	18.83		.009		31.0	
1.058[a]	2.280	2.354	.0060	.0057	33.3	32.2
20.46	2.65	2.65	.23	.70	32.2	32.2
38.32	17.36	17.00	.11	.09	[illegible]	[illegible]
41.62	16.69	14.40	.02	.11	30.2	22.0
66.62	54.17	51.00	.02	.04	29.2	28.5
72.78	21.45	21.50	.02	.22	27.5	28.6
90.77	12.85	13.00	.02	.08	38.3	30.7
92.51	3.12	3.20	.02	.20	29.5	30.7

[a] $g\Gamma_n\Gamma_\gamma$ for level at 1.058 eV: ENDF 75.92 meV^2
SOKRATOR 75.89 meV^2