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COHERENT OPTICAL AND STATISTICAL MODEL CALCULATIONS OF NEUTRON CROSS SECTIONS FOR ^{240}Pu AND ^{242}Pu BETWEEN 10 keV AND 20 MeV *

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COHERENT OPTICAL AND STATISTICAL MODEL CALCULATIONS OF NEUTRON CROSS SECTIONS FOR ^{240}Pu AND ^{242}Pu BETWEEN 10 keV AND 20 MeV*

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1 - INTRODUCTION

This paper presents a coherent application of the optical and statistical model to the calculations of direct and compound reaction cross sections for $^{240,242}Pu$ over the incident energy range 10 keV - 20 MeV. In a first step the total, the shape elastic and direct inelastic scattering cross sections were obtained, as explained in part 2, using the deformed optical potential formalism. In a second step the generalized neutron penetrabilities resulting from these calculations were introduced into our statistical model codes which calculate as explained in parts 3 and 5 the compound nuclear reactions such as compound elastic and inelastic scattering, radiative capture, fission, (n,2n) and (n,3n) reactions.

Comparisons of calculated excitation functions of all the above cross sections are made with experimental data or recent evaluations.

2 - COUPLED CHANNEL OPTICAL MODEL CALCULATIONS

As the nuclei considered here exhibit a high degree of deformity as shown by the low-lying collective states of their discrete spectra the neutron interactions must be analyzed in terms of a deformed optical potential that is in the frame of the coupled channel model [1].

The generalized local optical potential $V(r,\theta)$ takes the form :

$$V(r,\theta) = - Vf(r,a_o,R_o)+4ia_D W\frac{d}{dr} f(r,a_D,R_D)+\left(\frac{\hbar}{m_\pi c}\right)^2 \frac{1}{r}V_s \vec{\ell}.\vec{\sigma} \frac{d}{dr}f(r,a_s,R_s)$$

The quantities r,θ are the body-fixed coordinates and the radii R_o, R_D, R_s depend on the angle θ, deformation parameters β_2, β_4 and mass number A as follows :

$$R_o = r_o A^{1/3} [1 + \beta_2 Y_2^o (\theta) + \beta_4 Y_4^o (\theta)]$$

$$R_D = r_D A^{1/3} [1 + \beta_2 Y_2^o (\theta) + \beta_4 Y_4^o (\theta)]$$

$$R_s = r_s A^{1/3}$$

The function f(r,a,R) was taken to be of the Saxon-Woods form.

The potential was expanded in Legendre polynomials up to the order $\lambda = 8$. Calculations were performed using the (0^+, 2^+, 4^+) coupling base. In each case, the radial factors of the coupling terms were taken to be complex and the coupling potential was the same for all the channels and related to the diagonal potential.

We have chosen deformation parameters derived from calculations based on the Nilsson model and the method of Strutinsky as described by MÖLLER [2], and then we have slightly decreased their values as explained for ^{238}U and ^{232}Th in ref. [3]. The geometrical parameters were taken to be the same than those previously determined [3].

The strengths of the real (V) and imaginary (W) potentials were first adjusted so as to obtain for ^{240}Pu a good agreement for the s and p-wave strength functions, the scattering radius at low energy and the energy variation of the total cross section. In a second step an isospin dependence was introduced into the real and imaginary potentials. The values chosen for such symmetry terms are close to those previously determined for the isotopes of Samarium [4], Molybdenum [5] and for ^{93}Nb [6].

The various parameters so determined are presented in Table 1. The fit obtained on the experimental values of the strength functions and scattering radius are shown in Table 2. The experimental [7] and calculated total neutron cross sections from 100 keV to 1.5 MeV are given for ^{240}Pu in Fig.1. Comparisons between theoretical and evaluated values [8,9] of the neutron total cross sections for ^{240}Pu and ^{242}Pu are shown in Fig.2 and 3. The direct scattering and compound nucleus formation cross sections are given in Fig. 4 and 5.

Remark 1

To complete the comparison of total cross sections results let us mention that the evaluated values (BNL 325) [10] for ^{232}Th, ^{238}U, ^{235}U, ^{239}Pu, lie in the energy range 3 MeV - 4 MeV between 7.8 and 8 barns.

Our calculated results reproduce this trend for $^{240,242}Pu$, whereas the values reported on the evaluated files ENDF and ENDL are systematically smaller.

Remark 2

In order to reduce the extensive computation time the value of the strength of the spin-orbit potential was put equal to zero for neutron energies equal or greater than 10 MeV. In this high energy range calculational results are not very sensitive to the choice of this strength.

3 - RADIATIVE CAPTURE AND INELASTIC SCATTERING CROSS SECTIONS FROM 10 keV TO 3 MeV

The statistical model was used to calculate these cross sections following the method given in reference [11].

- The "neutron" penetrabilities were obtained from the above coupled channel calculations (cf Section 2).

- For ^{240}Pu, we have taken into account only 30 excited levels [12] due to the present dimensions of the code. For ^{242}Pu, only the first two levels were known by the time we did these calculations [13], so the other excited levels are those of ^{240}Pu. A recent data sheet giving the level scheme of ^{242}Pu shows that this hypothesis was correct.

Above the last excited level, the continuous level density follows the formalism of GILBERT and CAMERON [14], that is :

$$\rho_1 (E^*) \sim \exp \frac{E^* - E_o}{T} \quad \text{for} \quad E^* < E_x$$

$$\rho_2 (E^*) \sim \exp 2\sqrt{a(E^* - \delta)} \quad \text{for} \quad E^* > E_x$$

The level density parameters E_x, E_o, T, a were obtained from an adjustment to the mean level spacing D_{obs} [15] measured at the neutron resonance energies and to the discrete level scheme [12,13]. The pairing energies δ are taken from COOK [16].

We have adopted the radiative width given by AUCHAMPAUGH [17] for ^{240}Pu and the values of LYNN [18] for $^{241,242,243}Pu$. The neutron binding energies B_n are taken from WAPSTRA [19]. All these parameters are given in Table 3.

The barrier heights of the fission channels and their effective numbers were obtained by adjusting the calculated fission cross sections to the

experimental ones. The experimental fission cross section given by WESTON was used for ^{240}Pu [20] and that by MANN and SCHENTER [21] for ^{242}Pu.

The figures 6 and 7 show the fission cross sections. For ^{240}Pu, the adjustment of the calculated fission cross section was done by starting from the initial fission characteristics (double-humped barrier shape and transition-state spectrum) of ^{241}Pu given by THOMET [22]. This barrier shape is in good agreement with that given by AUCHAMPAUGH [23]. For ^{242}Pu, the initial fission characteristics of ^{243}Pu are those of BACK [24]. This barrier shape is not very different from that given by AUCHAMPAUGH [25].

The barrier heights and the effective number of fission channels were adjusted following the method described in [11].

4 - RESULTS

The figures 8 and 9 give a comparison between the experimental capture cross sections [26], some evaluations [8,9,20,21] and the present calculations. The agreement is rather good.

The calculated elastic scattering cross section of ^{240}Pu is also in good agreement with the experimental results of SMITH [7](fig. 10a).

The figure 10b shows the calculated inelastic scattering cross section together with other recent evaluations [8,9].

Some partial inelastic scattering cross sections for ^{240}Pu are compared with the experimental results of SMITH [7], (fig. 11 and 12). The excitation energy E_x = 600 keV corresponds to the two levels at 597 keV and 649 keV, while E_x = 900 keV is taken for the levels at 861, 900, 938 and 959 keV.

The figures 13 and 14a give a comparison between the calculated scattering cross sections of ^{242}Pu and other evaluations [8,9].

5 - (n,xn) AND (n,xnf) REACTION CROSS SECTIONS FROM 3 MeV TO 20 MeV.

These cross sections were calculated following the statistical model version described in ref.[27]. The level density parameters employed are given in Table 3. The compound nucleus formation cross section and the inverse reaction cross sections needed for these calculations are obtained from the above coupled channel optical model. A comparison is shown between these calculations and other recent evaluations [8,9] on figures 14b and 15.

The calculated cross sections of ^{240}Pu are given in Tables 4, 5 and 6 and the neutron cross sections of ^{242}Pu are tabulated in Tables 7, 8 and 9. The results of coupled channel calculations are tabulated in the Appendix 1A to 2B.

6 - CONCLUSION

We have obtained over a large incident energy range a complete and coherent set of a number of important cross sections by using conjointly the optical and statistical models. The methods tested for ^{240}Pu can be extended with confidence to provide a consistent set of calculated cross sections for the less known ^{242}Pu nucleus.

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TABLE 1

$V = 49.82 - 17\left(\frac{N-Z}{A}\right) - 0.3\,E_n$	$a_o = 0.63$ fm	$r_o = 1.26$ fm
$V_s = 6.2$	$a_s = 0.47$ fm	$r_s = 1.12$ fm
$W = \begin{cases} 5.52 - 9\left(\frac{N-Z}{A}\right) + 0.4\,E_n & E_n \leq 10 \text{ MeV} \\ 9.52 - 9\left(\frac{N-Z}{A}\right) & E_n \geq 10 \text{ MeV} \end{cases}$	$a_D = 0.52$ fm	$r_D = 1.26$ fm

Optical model parameters

(Energies are in MeV, Lengths in fermis)

TABLE 2

TYPE	$S_o \times 10^{+4}$	$S_1 \times 10^{+4}$
^{240}Pu $\beta_2 = 0.200$ $\beta_4 = 0.062$	1.00	2.31*
^{240}Pu Recommended values	0.94 ± 0.09	
^{242}Pu $\beta_2 = 0.204$ $\beta_4 = 0.051$	1.00	2.63*
^{242}Pu Recommended values	0.9 ± 0.1	

Comparisons of calculated and recommended values [15] of strength functions (S_0, S_1).

* Calculated with $r_o = 1.26\ A^{1/3}$.

TABLE 3

Compound nucleus	D_{obs} (eV)	a $(MeV)^{-1}$	Pairing (MeV)	B_n (MeV)	E_x (MeV)	E_o (MeV)	T (MeV)	Γ_γ^{exp} (meV)
^{240}Pu	2.3±0.1	26.757	0.97	6.534	3.7019	0	0.37782	42
^{241}Pu	13.6±0.4	27.943	0.49	5.24	3.2068	-0.5	0.37666	30.8
^{242}Pu	1±0.1	28.002	1.1	6.309	3.9919	0	0.38565	42
^{243}Pu	16.5±0.5	29.869	0.71	5.037	3.7209	-0.5	0.37715	27

Statistical model parameters

TABLE 4

Neutron energy	Total cross section	Total inél. cross section	Radiative capture cross section	Fission cross section
0.01	15641		1064	78
0.02	14424		818	83
0.03	13854		693	85
0.04	13483		610	87
0.05			526	84
0.06	12835	164	451	81
0.07			395	79.7
0.08	12453	334	354	80
0.09			322	81.2
0.10	12133	452	297	83
0.20	10989	771	190	126
0.40	9272	1143	203	207
0.60	8135	1139	160	730
0.80	7436	1283	129	1160
1.0	7070	1405	109	1486
1.4		1880	86.4	1583
2.0	7373	2115	66.8	1706
3.0	7912	2035	18.2	1700

Total, inelastic, capture and fission cross sections of (^{240}Pu + n) (mb).

TABLE 5

Neutron Energy (MeV)	Total cross section	Elastic cross section	Inelastic cross section	Fission cross section	(n,2n) cross section	(n,3n) cross section
4	7946	4443	1890	1613		
5	7608	4283	1783	1542		
6	7103	3878	1635	1590		
7	6622	3422	1116.51	2069	14.49	
8	6237	3036	610.7	2403	187.3	
9				2333	299.1	
10	5856	2641	602.4	2295	317.6	
12	5677	2604	502.3	2236	334.7	
13.5				2222	449.9	13.46
14	5764	2791				
15				2471	363	68.2
16	6020	3094				
18	6279	3390	342.9	2277	127.7	141.4
20	6436	3593	265.3	2361	63.9	152.8

Total, elastic, inelastic, fission and (n,xn) cross sections of (^{240}Pu + n) (mb).

(^{240}Pu + n) PARTIAL INELASTIC AND ELASTIC CROSS SECTIONS (mb)

Energy of the level (MeV)	J^{π}	Neutron energy (MeV)																		
		0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.1	0.2	0.3	0.4	0.6	0.8	1.	1.4	2.	3.
0	0^+	14498	13518	13067	12772	12448	12115	11874	11649	11440	11231	9773	8600	7668	6102	4865	4066	3398	3486	4157
0.042825	2^+					59	164	256	334	398	452	771	981	1100	992	801	666	538	505	429.8
0.14169	4^+												6	43	119	182	217	230	208	141
0.29431	6^+														28	3	7	17.9	22.3	4.8
0.49760	8^+																0	0.18	0.9	0.78
0.59736	1^-															223	218	129	56.7	7.1
0.64889	3^-															63	109	107	66.3	10.2
0.74250	5^-																5.5	19.4	24.9	6
0.75140	10^+																0	0	0	0
0.86070	0^+																47.5	45.1	21	2.9
0.90032	2^+																61.1	110	66.4	10
0.93807	1^-																47.3	85.8	46.8	6.6
0.95887	2^-																24.8	85.8	56.3	8.9
0.99260	4^+																	41	42.3	8.7
1.0018	3^-																	60.4	50.8	9.2
1.0306	3^+																	66.6	56.9	10.1
1.0379	4^-																	30.8	34.2	7.7
1.0764	4^+																	32.9	38.8	8.4
1.0897	0^+																	29.2	17.7	2.7
1.1157	5^-																	5.7	15.4	5.1
1.1375	2^+																	63.9	55.4	9.2
1.1613	6^-																	1.8	6.3	2.8
1.1780	3^+																	41.3	49.7	9.6
1.2231	2^+																	42.7	51.4	8.9
1.2324	4^+																	15.7	32.9	7.8
1.2408	1^-																	33.3	36.9	5.9
1.2621	3^+																	24.3	45.6	9.2
1.2820	3^-																	18.8	38.1	8.2
1.3086	5^-																	1.08	11.3	4.5
1.4108	0^+																	0	12.7	2.4
Continuum																			442.6	1286

TABLE 6

TABLE 7

Neutron energy (MeV)	Total cross section	Total inelastic cross section	Radiative capture cross section	Fission cross section
0.01	15769		981	20
0.02	14587		746	18
0.03	14040		623	16
0.04	13685		543	15
0.06	13052	194	387	12
0.08	12683	403	297	11
0.10	12368	543	248	15
0.20	11212	908	163	35
0.30	10400			
0.40	9555	1273	166	120
0.50	8958			
0.60	8432	1432	175	380
0.70	8021			
0.80	7702	1621	137	864
1.00	7299	1665	108	1328
1.25	7130			
1.50	7160			
2.0	7428	2301	60	1544
2.5	7716			
3.0	7899	2397	20	1350

Total, inelastic, capture and fission cross sections of (^{242}Pu + n) (mb).

TABLE 8

Neutron energy (MeV)	Total cross section	Elastic cross section	Inelastic cross section	Fission cross section	(n,2n) cross section	(n,3n) cross section
4	7928	4410	2241	1270		
5	7608	4261	2144	1200		
6	7122	3870	1771	1480		
7	6652	3425	1319	1816	92	
8	6270	3046	859	1908	455	
9	5992	2779	634	1902	677	
10	5886	2657	513	1904	812	
11.6	5739					0
12	5702	2617	348	1806	927	3.2
14	5792	2805	279			
15	5912	2928	295	1905	237	547
16	6048	3109	265			
18	6304	3405	263	2012	21	602
20	6459	3607	250	2029	5	567

Total, elastic, inelastic, fission and (n,xn) cross sections of (^{242}Pu + n) (mb).

(^{242}Pu + n) Partial inelastic and elastic cross sections (mb)

Energy of the level (MeV)	J^{π}	Neutron energy (MeV)													
		0.01	0.02	0.03	0.04	0.06	0.08	0.10	0.2	0.4	0.6	0.8	1.0	2.0	3.0
0.	0^+	16788	15085	13991	13127	12458	11972	11562	10106	7996	6445	5080	4198	3523	4132
0.044525	2^+					193	403	542	908	1225	1225	951	741	551	466
0.14169	4^+									48	178	244	255	216	147
0.29431	6^+											4.8	9.5	24.5	6.6
0.49760	8^+													1.0	1.0
0.59736	1^-										27.7	299	271.5	63.0	10.0
0.64889	3^-											122	171.0	73.0	14.0
0.74250	5^-												8.9	27.6	8.3
0.75140	10^+											0	0	0	0
0.86070	0^+												46.0	23.0	4.1
0.90032	2^+												75.5	73.8	13.9
0.93807	1^-												51.2	52.2	9.2
0.95887	2^-												33.2	62.7	12.4
0.99260	4^+												1.0	47.4	12.1
1.0018	3^-													56.5	12.8
1.0306	3^+													63.9	14.1
1.0379	4^-													38.1	10.6
1.0764	4^+													43.6	11.7
1.0897	0^+													19.7	3.8
1.1157	5^-													17.3	7.0
1.1375	2^+													62.1	13.0
1.1613	6^-													7.0	3.9
1.1780	3^+													56.3	13.4
1.2231	2^+													57.9	12.6
1.2324	4^+													37.3	10.9
1.2408	1^-													41.6	8.4
1.2621	3^+													51.9	12.9
1.2820	3^-													42.7	11.5
1.3086	5^-													12.7	6.3
1.4108	0^+													14.4	3.3
Continuum														462	1536

TABLE 9

FIGURE CAPTIONS

Fig. 1 - Measured [7] and calculated total cross section of ^{240}Pu. The solid curve denotes the results of model calculations as described in the text.

Fig. 2 - Total cross sections for ^{240}Pu. Comparisons between results of model calculations and previous evaluations (ENDF-BIV, ENDL 76, ref. [8,9]).

Fig. 3 - Total cross sections for ^{242}Pu. Comparisons between results of model calculations and previous evaluations (ENDF-BIV, ENDL 76).

Fig. 4 - Direct elastic, inelastic scattering and compound nucleus formation cross section for ^{240}Pu. Curves are obtained from calculation.

Fig. 5 - Direct elastic, inelastic scattering and compound nucleus formation cross section for ^{242}Pu. Curves are obtained from calculation.

Fig. 6 - Measured [28], evaluated [20] and calculated fission cross section for ^{240}Pu. The dotted curve denotes the results of model calculations as described in the text.

Fig. 7 - Measured [29], evaluated [21] and calculated fission cross sections for ^{242}Pu. The dotted curve denotes the results of model calculations as described in the text.

Fig. 8 - Measured [26], evaluated [20] and calculated neutron capture cross sections for ^{240}Pu. The dash-dotted curve denotes the results of model calculations as described in the text.

Fig. 9 - Measured [26], evaluated [8,9,21] and calculated neutron capture cross sections for ^{242}Pu. The dotted curve denotes the results of model calculations as described in the text.

Fig. 10/11/12 - Measured [7] and calculated elastic and inelastic scattering cross sections for ^{240}Pu. The observed inelastic excitation cross sections are associated for the 600 keV group with the following individual states 597 keV (1^-), 693 keV (3^-) and for the 900 keV group with the following individual states 861 keV (0^+), 900 keV (2^+), 938 keV (2^+) and 959 keV (2^-). The solid curves denote the results of model calculations as described in the text.

Fig. 13 - Calculated (solid curve) and evaluated (ENDF,ENDL) neutron scattering cross sections for ^{242}Pu.

Fig. 14a - Calculated (solid curve) and evaluated (ENDF,ENDL) total neutron inelastic scattering cross sections for ^{242}Pu.

Fig. 14b - Calculated (solid curve) and evaluated (ENDF,ENDL) (n,2n), (n,3n) cross sections for ^{240}Pu.

Fig. 15 - Calculated (solid curve) and evaluated (ENDF,ENDL) (n,2n), (n,3n) cross sections for ^{242}Pu.

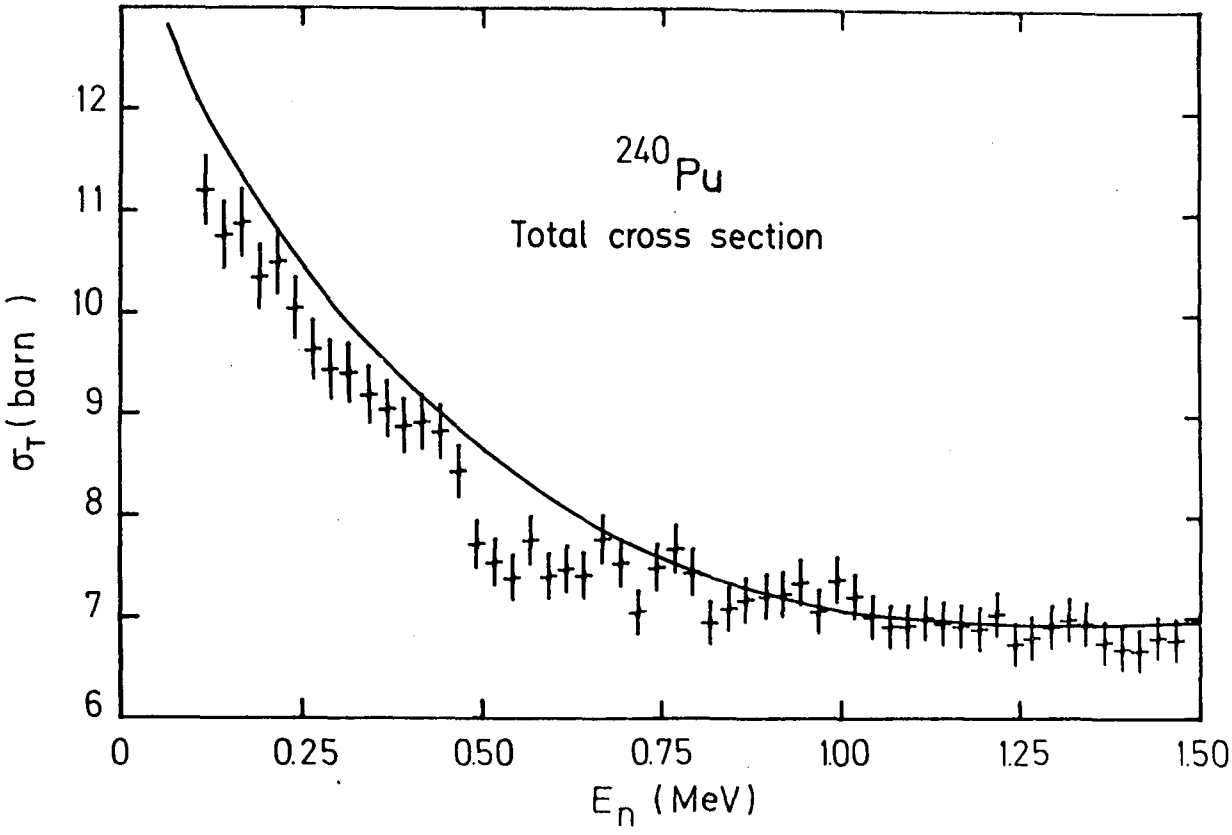

^{240}Pu
Total cross section
σ_T (barn)
12
11
10
9
8
7
6
0
0.25
0.50
0.75
1.00
1.25
1.50
E_n (MeV)

Fig. 1

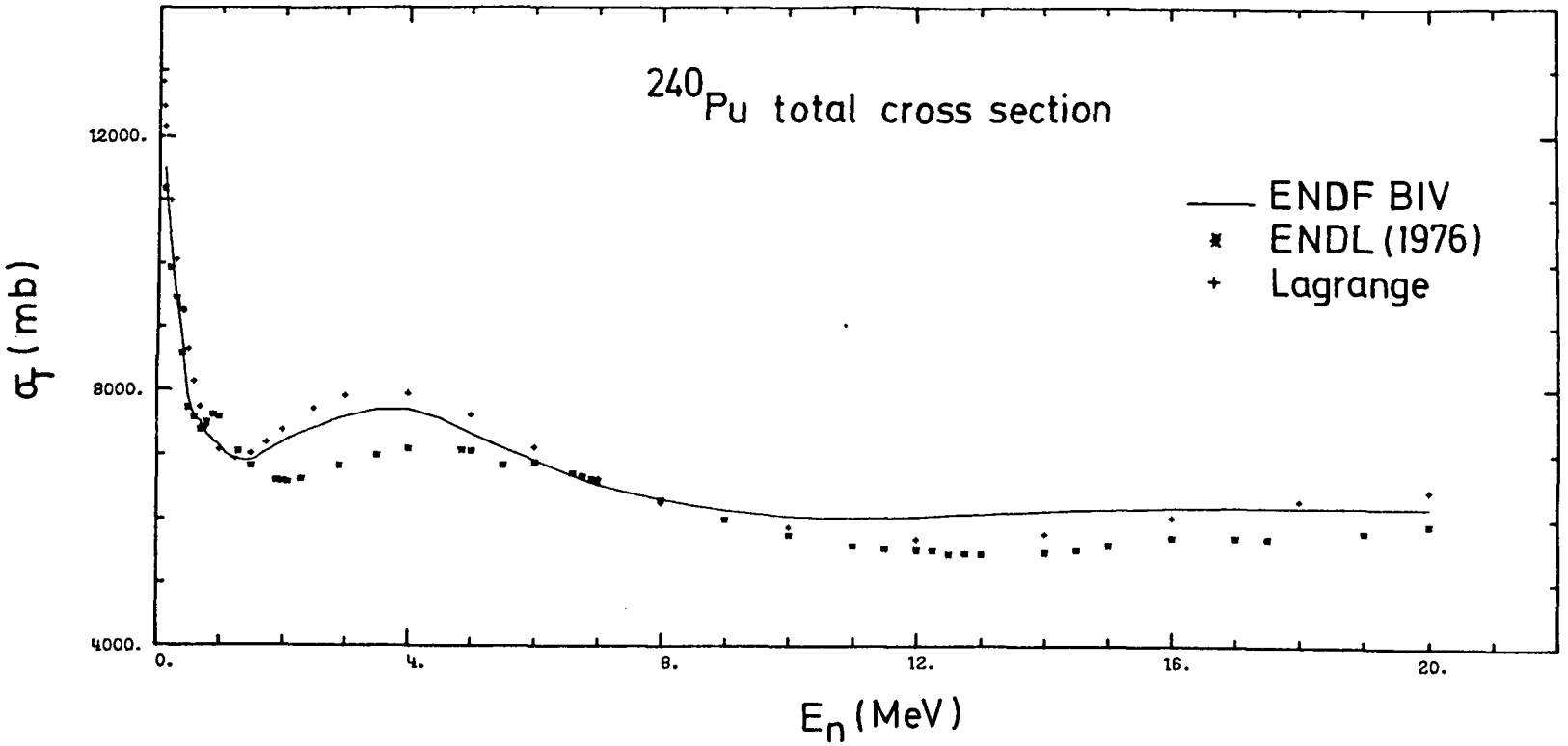

240Pu total cross section
ENDF BIV
ENDL (1976)
Lagrange
12000.
8000.
4000.
0.
4.
8.
12.
16.
20.
σt (mb)
En (MeV)

Fig. 2

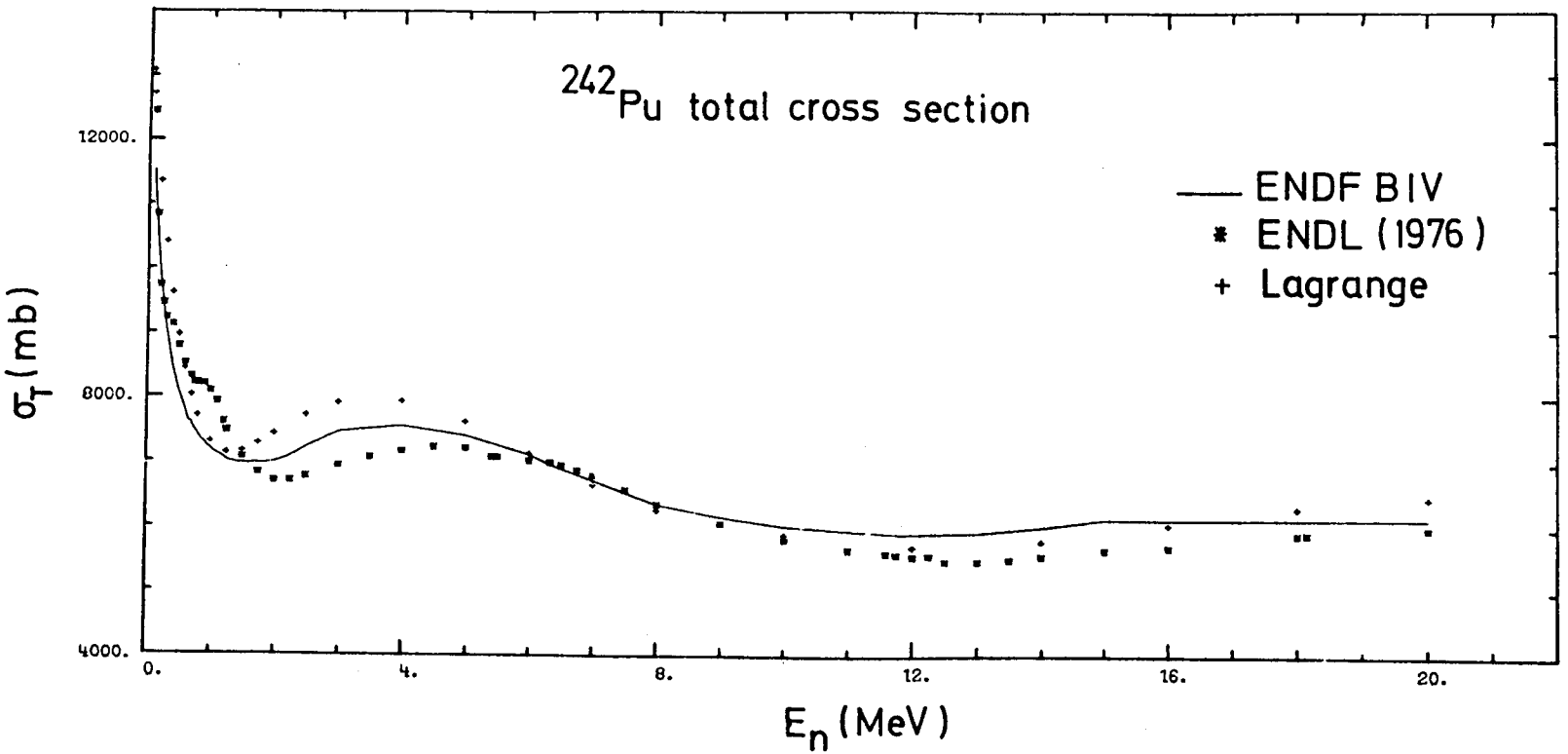

242Pu total cross section
ENDF BIV
ENDL (1976)
Lagrange
σT (mb)
12000.
8000.
4000.
0.
4.
8.
12.
16.
20.
En (MeV)

Fig. 3

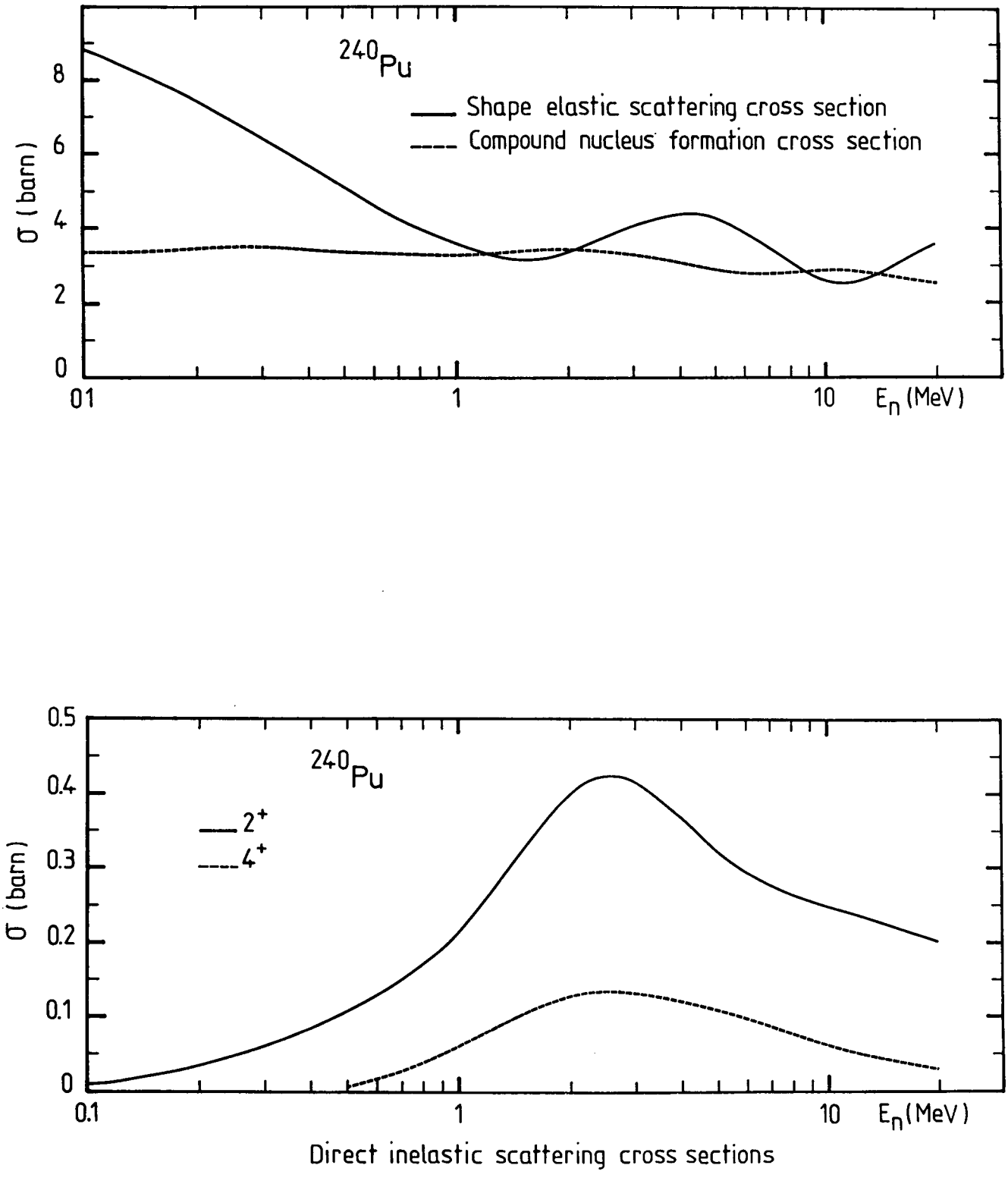
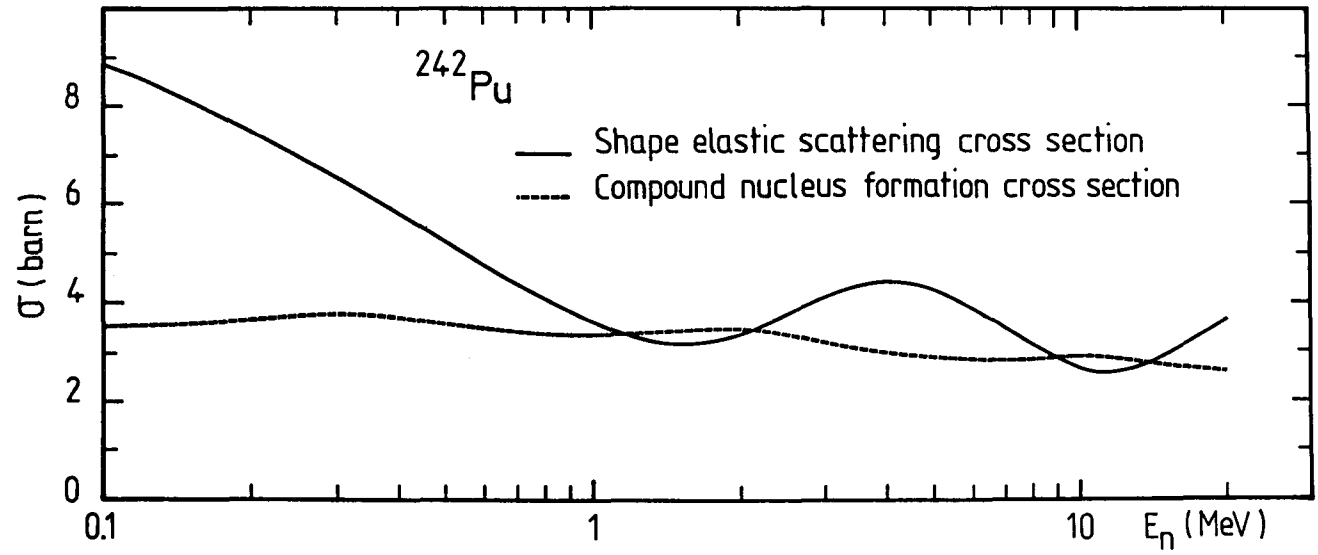
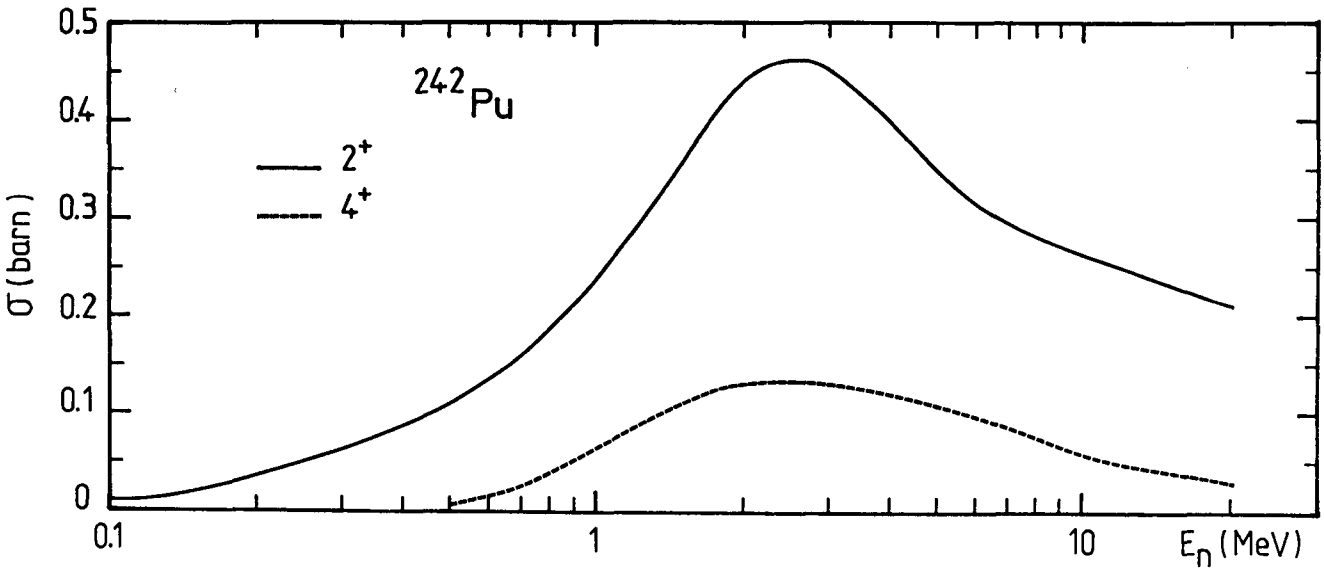

240Pu
Shape elastic scattering cross section
Compound nucleus formation cross section
σ (barn)
8
6
4
2
0
01
1
10
En (MeV)
0.5
0.4
0.3
0.2
0.1
0
240Pu
2+
4+
σ (barn)
0.1
1
10
En (MeV)
Direct inelastic scattering cross sections

Fig. 4





Direct inelastic scattering cross sections

Fig. 5

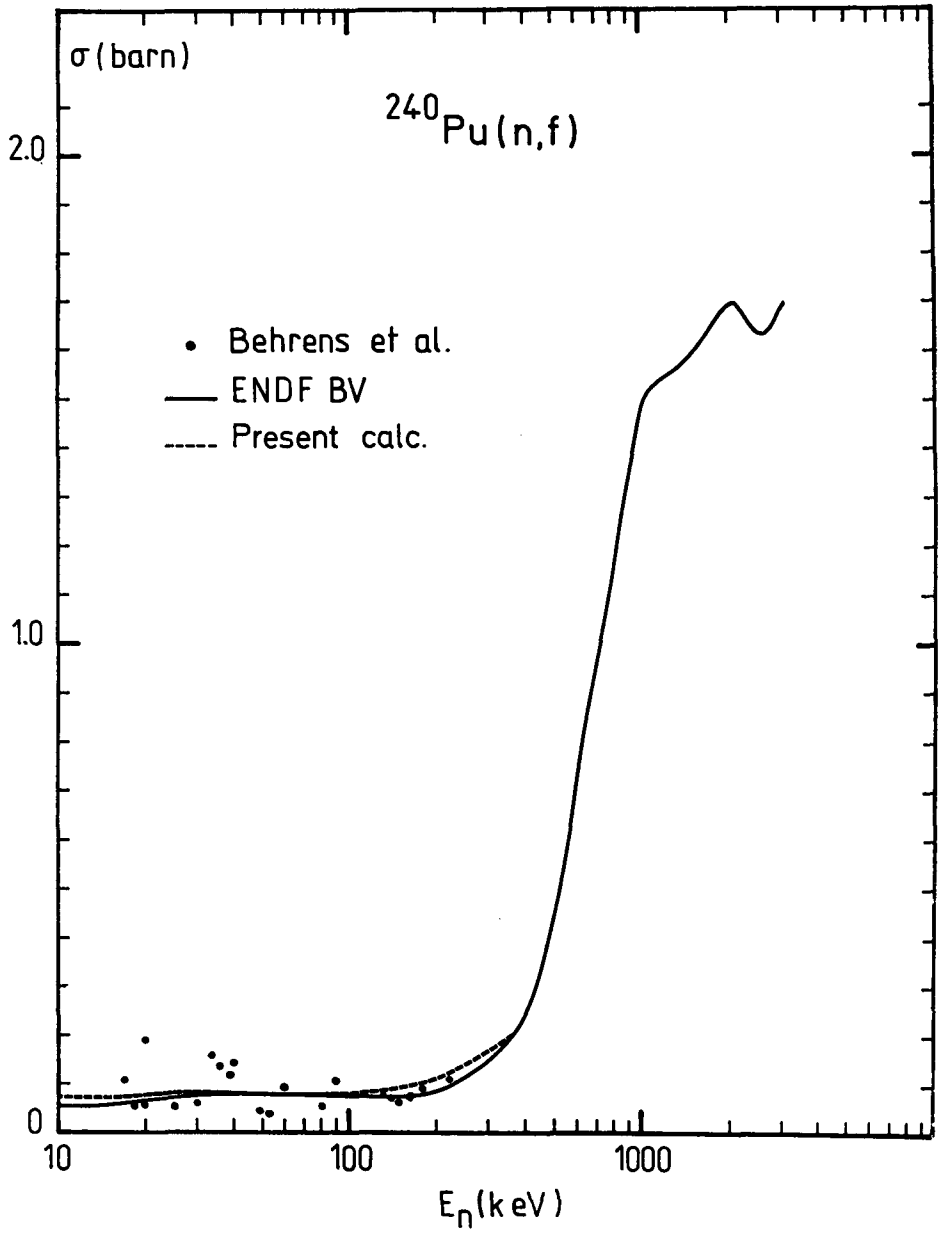

σ (barn)
240Pu(n,f)
2.0
1.0
0
• Behrens et al.
ENDF BV
Present calc.
10
100
1000
En(keV)

Fig. 6

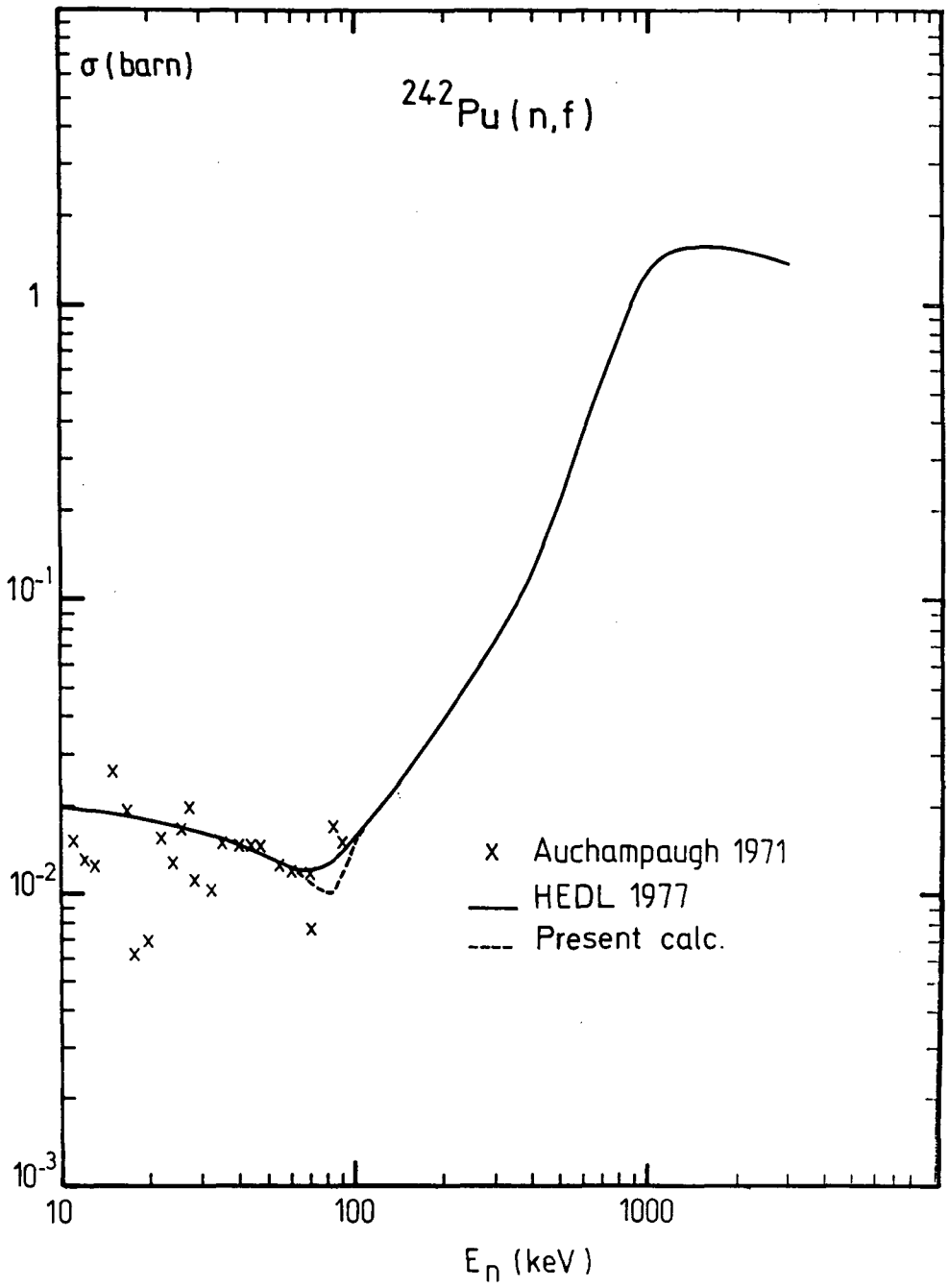

σ (barn)
242Pu (n,f)
1
10-1
10-2
10-3
10
100
1000
En (keV)
x Auchampaugh 1971
HEDL 1977
Present calc.

Fig. 7

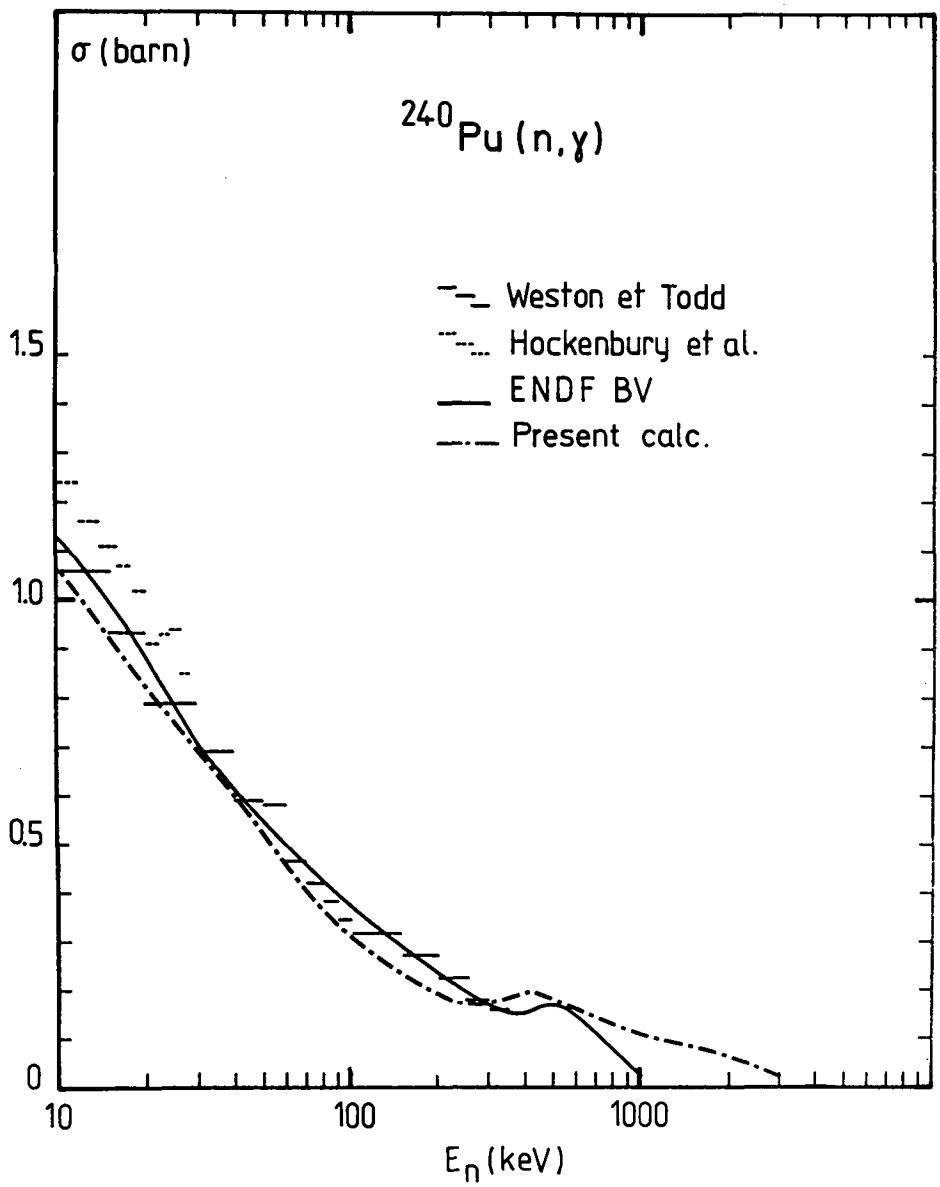

σ (barn)
240Pu (n,γ)
Weston et Todd
Hockenbury et al.
ENDF BV
Present calc.
1.5
1.0
0.5
0
10
100
1000
En (keV)

Fig. 8

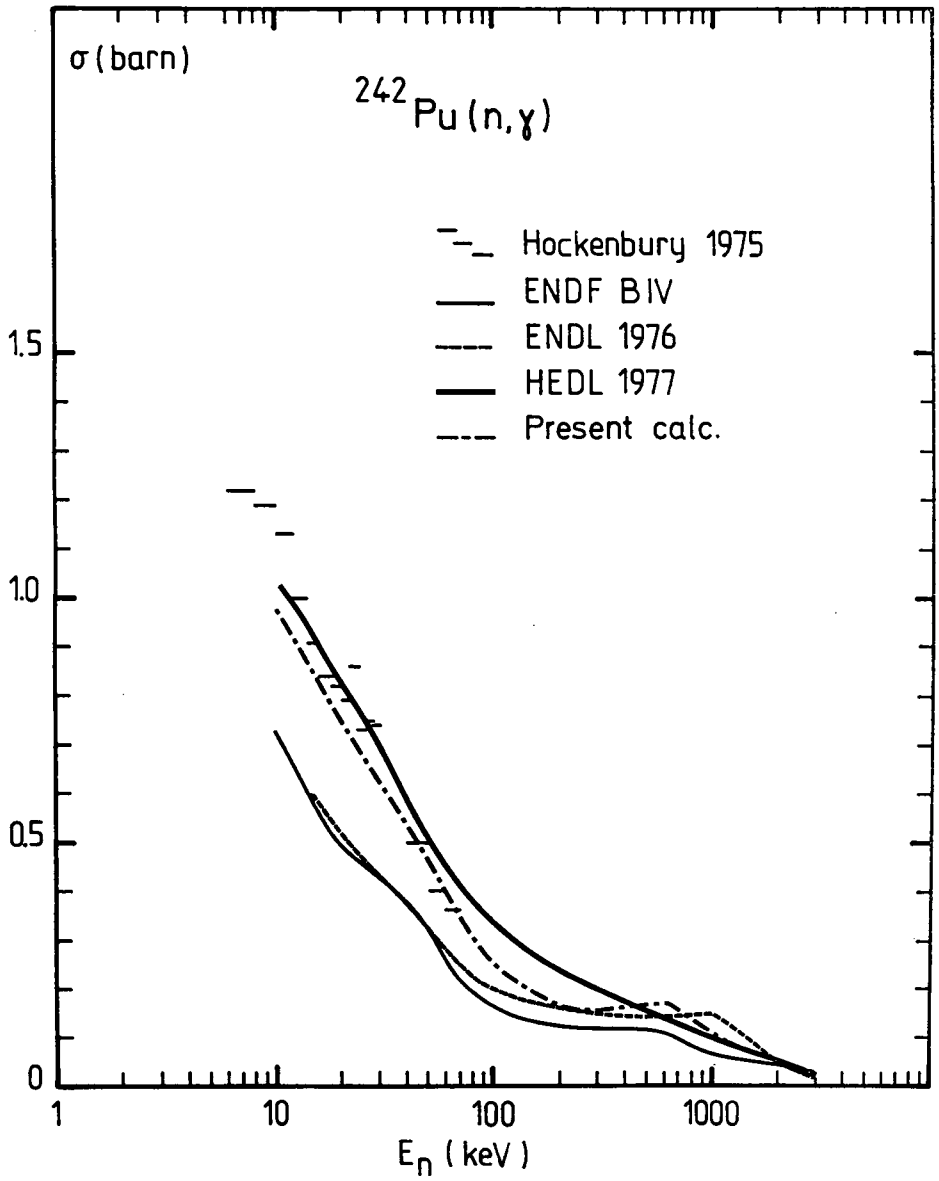
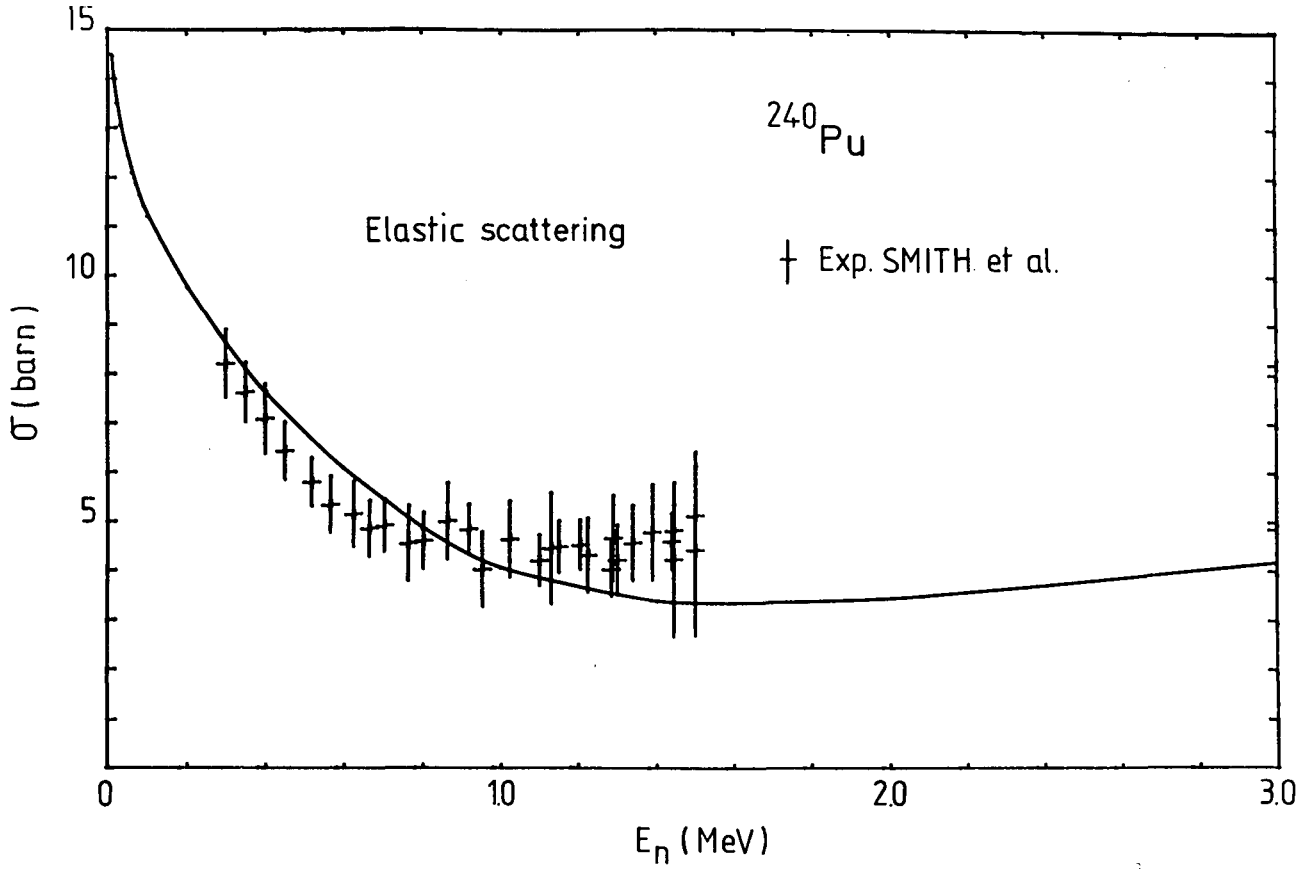

σ (barn)
242Pu (n,γ)
Hockenbury 1975
ENDF BIV
ENDL 1976
HEDL 1977
Present calc.
1.5
1.0
0.5
0
1
10
100
1000
En (keV)

Fig. 9

(a)


15
10
5
0
1.0
2.0
3.0
σ (barn)
E_n (MeV)
^{240}Pu
Elastic scattering
Exp. SMITH et al.

(b)

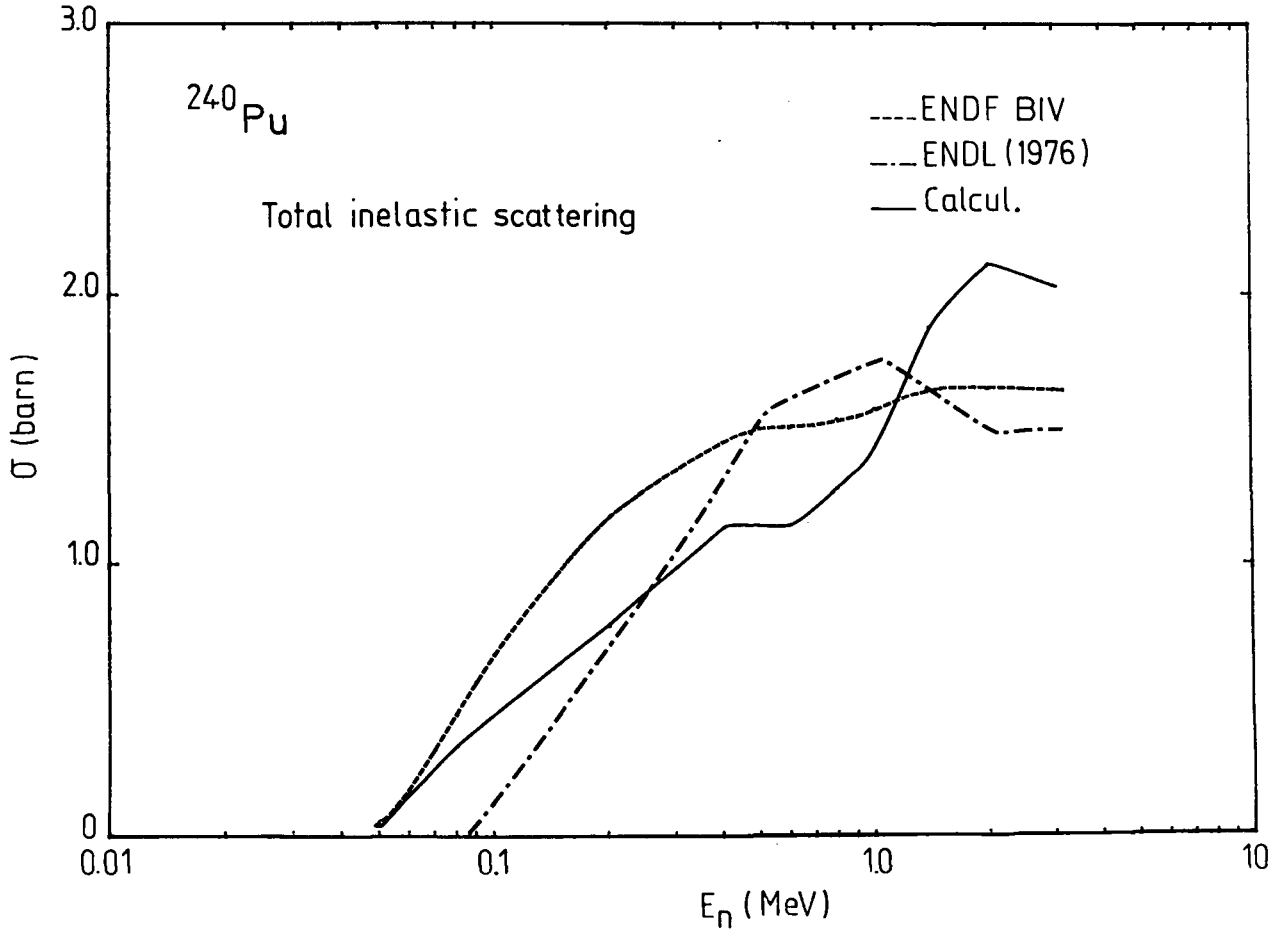
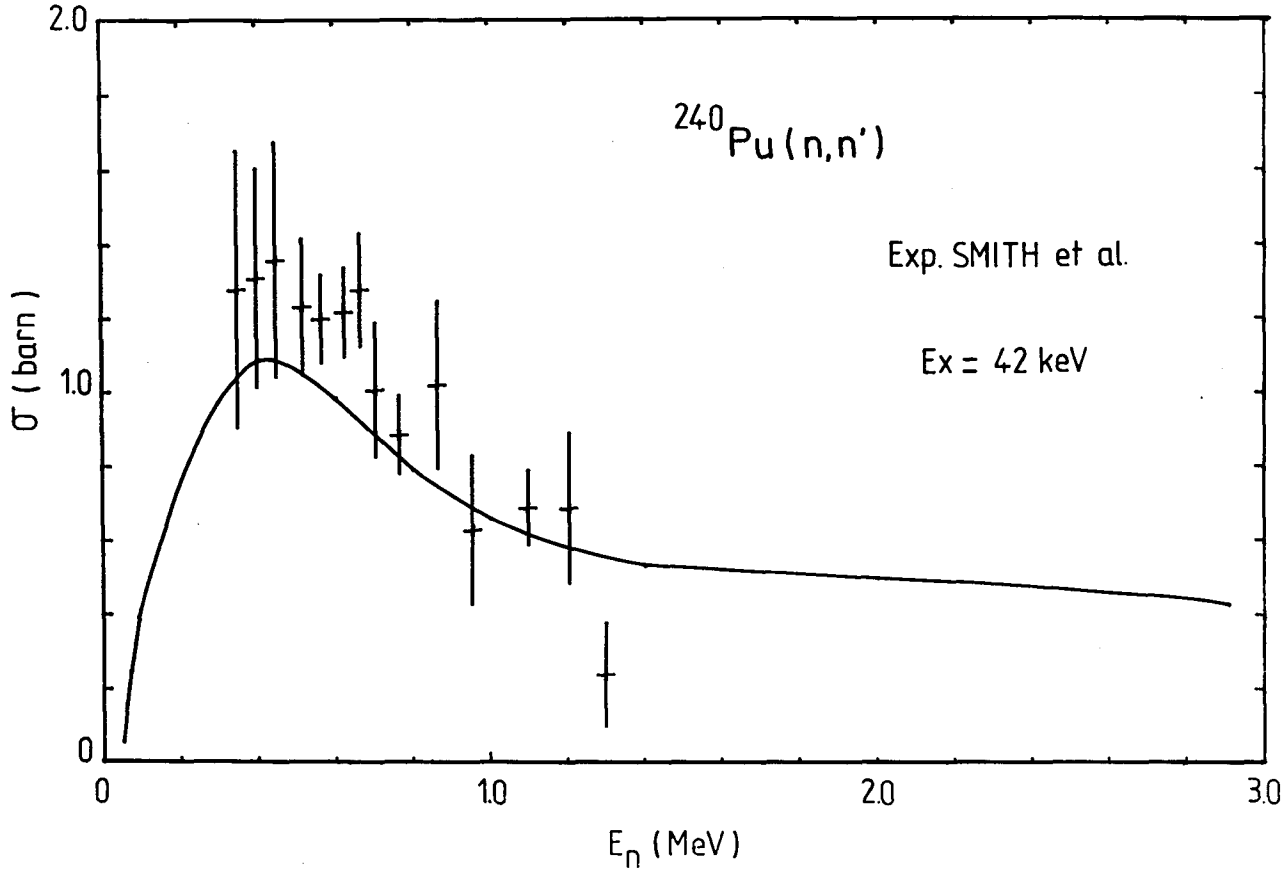

3.0
2.0
1.0
0
0.01
0.1
1.0
10
σ (barn)
E_n (MeV)
^{240}Pu
Total inelastic scattering
ENDF BIV
ENDL (1976)
Calcul.

Fig. 10

(a)


2.0
1.0
0
σ (barn)
240Pu (n,n')
Exp. SMITH et al.
Ex = 42 keV
0
1.0
2.0
3.0
En (MeV)

(b)

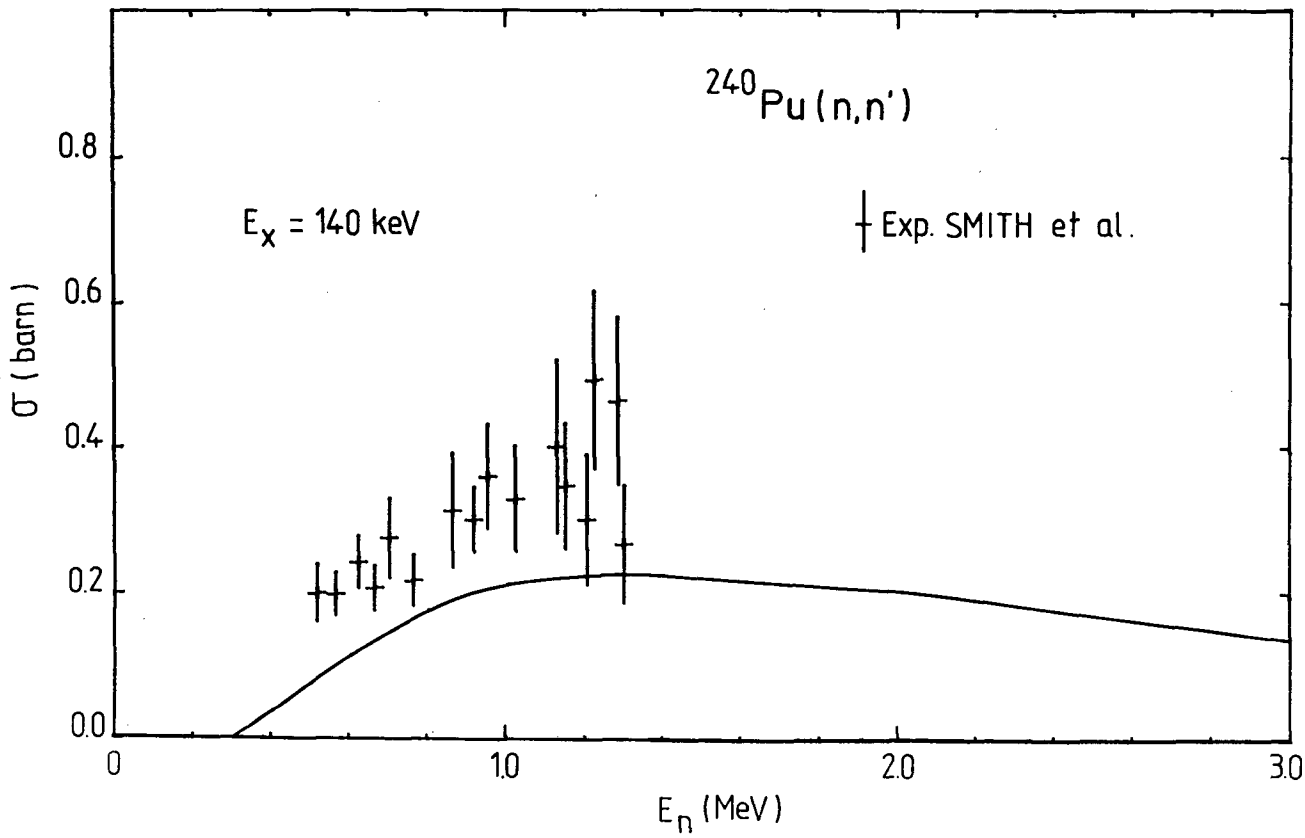
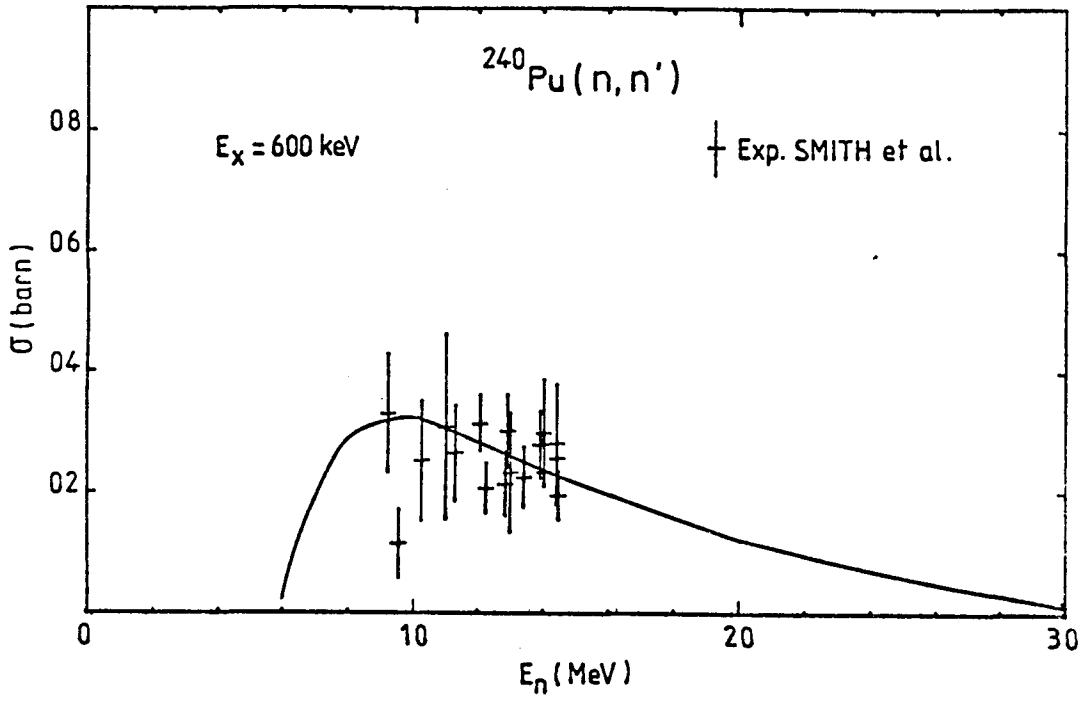

0.8
0.6
0.4
0.2
0.0
σ (barn)
240Pu (n,n')
Ex = 140 keV
Exp. SMITH et al.
0
1.0
2.0
3.0
En (MeV)

Fig. 11

(a)


240Pu (n, n')
Ex = 600 keV
Exp. SMITH et al.
σ (barn)
0.8
0.6
0.4
0.2
0
10
20
30
En (MeV)

(b)

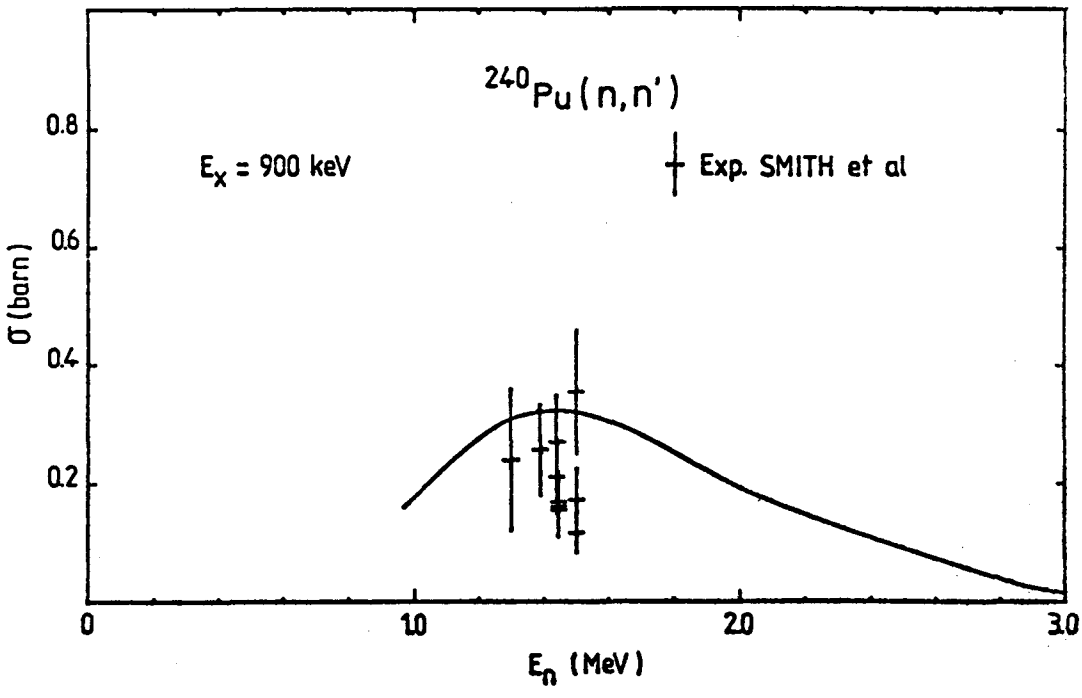

240Pu (n,n')
Ex = 900 keV
Exp. SMITH et al
σ (barn)
0.8
0.6
0.4
0.2
0
1.0
2.0
3.0
En (MeV)

Fig. 12

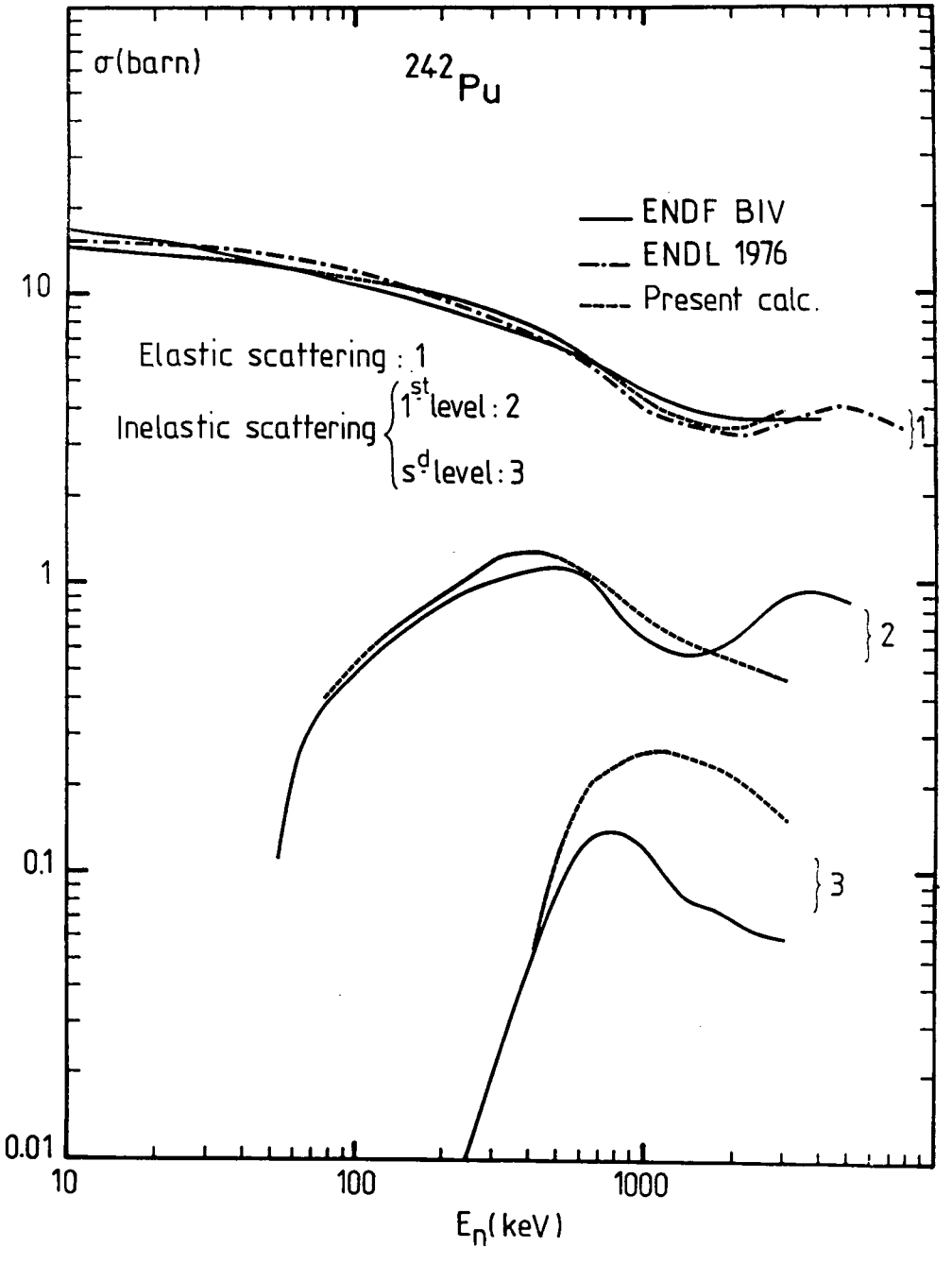
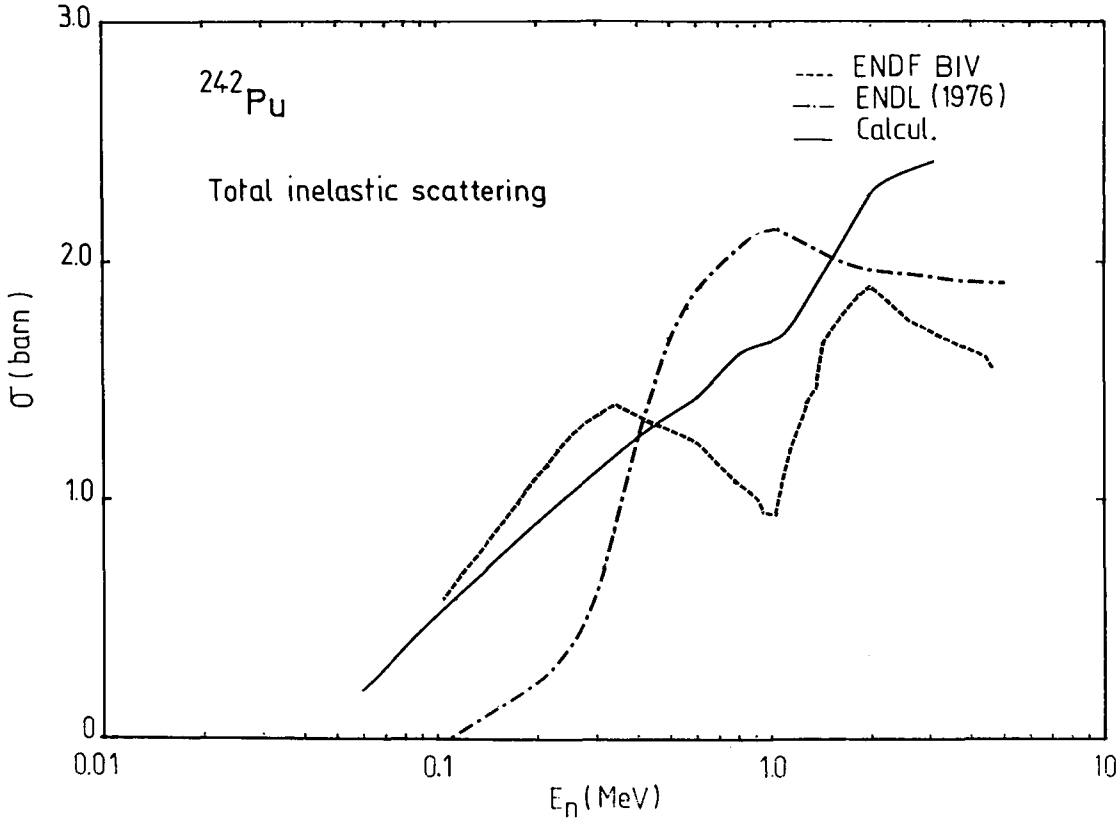

σ(barn)
242Pu
ENDF BIV
ENDL 1976
Present calc.
Elastic scattering : 1
Inelastic scattering
1st level : 2
sd level : 3
1
2
3
10
1
0.1
0.01
10
100
1000
En(keV)

Fig. 13

(a)


3.0
2.0
1.0
0
0.01
0.1
1.0
10
σ (barn)
E_n (MeV)
^{242}Pu
Total inelastic scattering
ENDF BIV
ENDL (1976)
Calcul.

(b)

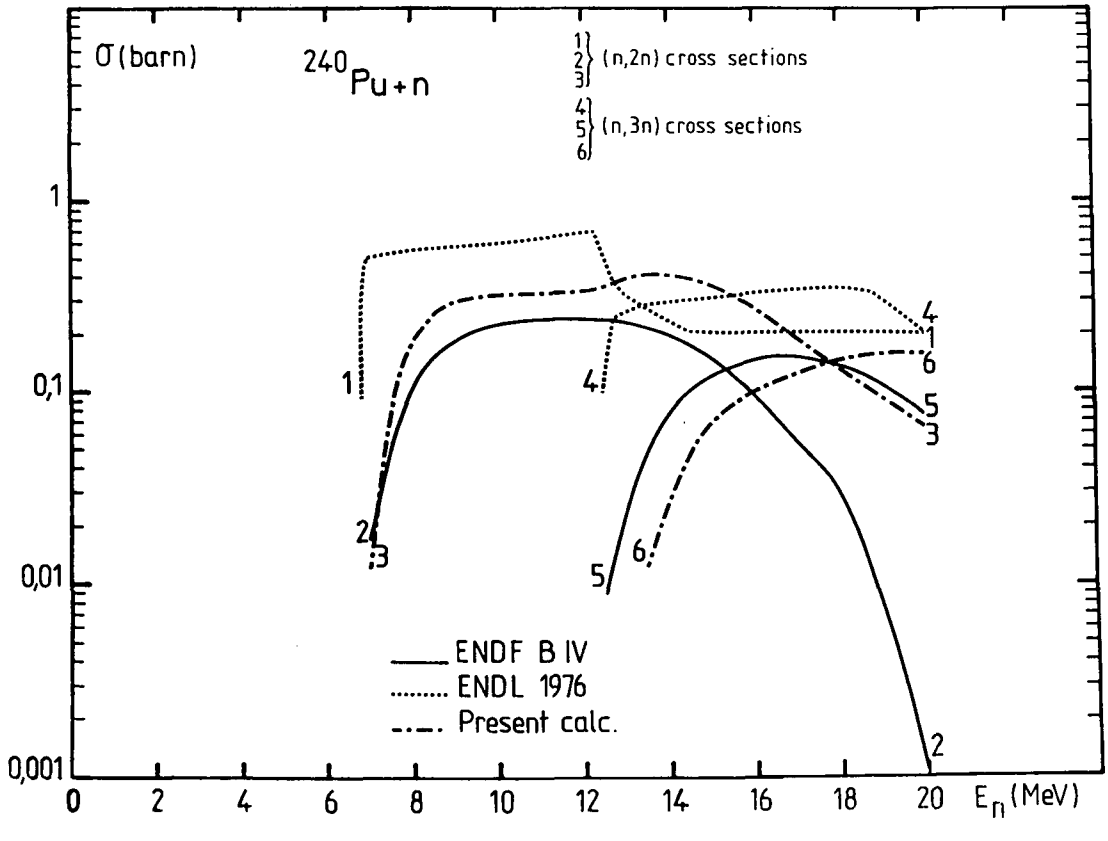

σ (barn)
^{240}Pu+n
1, 2, 3 (n,2n) cross sections
4, 5, 6 (n,3n) cross sections
1
0,1
0,01
0,001
0
2
4
6
8
10
12
14
16
18
20
E_n (MeV)
ENDF B IV
ENDL 1976
Present calc.

Fig. 14

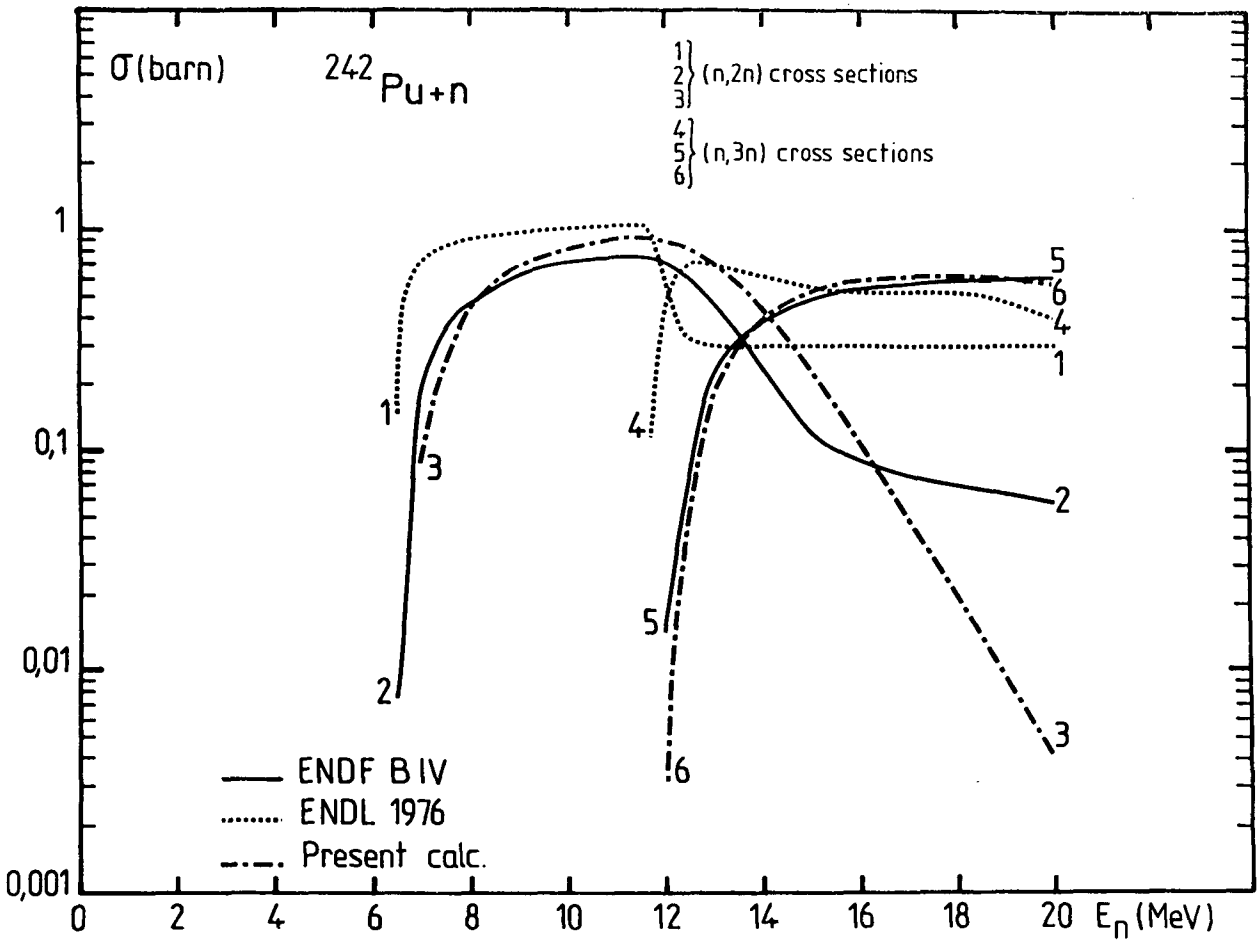

σ(barn)
242 Pu+n
1 2 3 (n,2n) cross sections
4 5 6 (n,3n) cross sections
1
0,1
0,01
0,001
0
2
4
6
8
10
12
14
16
18
20
E_n (MeV)
ENDF B IV
ENDL 1976
Present calc.

Fig.15

APPENDIX 1A

RESULTS OF COUPLED CHANNEL CALCULATIONS FOR ^{240}Pu :

CROSS SECTIONS AND ANGULAR DISTRIBUTIONS (units are : cross section in barn, energy in eV).

The angular distributions are represented as Legendre polynomial coefficients. The absolute differential cross sections are obtained by :

$$\frac{d\sigma}{d\Omega}(\Omega, E) = \frac{A}{2\pi} \sum_{\ell=o}^{NL} \frac{2\ell+1}{2} B_\ell(E) \; P_\ell(u)$$

with $A = 1.0$ if $E < 3.5$ MeV and $B_o = \sigma_s(E)$

$A = \sigma_s(E)$ if $E > 3.5$ MeV and $B_o = 1.0$

where : u = cosine of the scattering angle in the centre of mass system

- E energy of the incident neutron in the laboratory system
- $\sigma_s(E)$ the scattering cross section
- B_ℓ the ℓth Legendre polynomial coefficient
- $\frac{d\sigma}{d\Omega}(\Omega,E)$ differential cross sections in units of barn per steradian.

COUPLED CHANNEL CALCULATIONS FOR PLUTONIUM 240 (CH,LAGRANGE.77)

NEUTRON TOTAL CROSS SECTIONS

E	S(E)	E	S(E)	E	S(E)
1.0000D 03	2.4631D 01	5.0000D 03	1.7343D 01	1.0000D 04	1.5641D 01
2.0000D 04	1.4424D 01	3.0000D 04	1.3854D 01	4.0000D 04	1.3483D 01
6.0000D 04	1.2835D 01	8.0000D 04	1.2453D 01	1.0000D 05	1.2133D 01
2.0000D 05	1.0989D 01	3.0000D 05	1.0049D 01	4.0000D 05	9.2720D 00
5.0000D 05	8.6394D 00	6.0000D 05	8.1354D 00	7.0000D 05	7.7384D 00
8.0000D 05	7.4364D 00	1.0000D 06	7.0701D 00	1.2500D 06	6.9348D 00
1.5000D 06	7.0122D 00	1.7500D 06	7.1818D 00	2.0000D 06	7.3735D 00
2.5000D 06	7.7070D 00	3.0000D 06	7.9121D 00	4.0000D 06	7.9461D 00
5.0000D 06	7.6077D 00	6.0000D 06	7.1031D 00	7.0000D 06	6.6222D 00
8.0000D 06	6.2370D 00	1.0000D 07	5.8563D 00	1.2000D 07	5.6768D 00
1.4000D 07	5.7642D 00	1.6000D 07	6.0199D 00	1.8000D 07	6.2794D 00
2.0000D 07	6.4363D 00	0.0	0.0	0.0	0.0

COUPLED CHANNEL CALCULATIONS FOR PLUTONIUM 240 (CH,LAGRANGE,77)

NEUTRON COMPOUND NUCLEUS FORMATION CROSS SECTIONS

E	S(E)	E	S(E)	E	S(E)
1.0000D 03	1.3515D 01	5.0000D 03	6.4299D 00	1.0000D 04	4.9085D 00
2.0000D 04	3.9853D 00	3.0000D 04	3.6663D 00	4.0000D 04	3.5222D 00
6.0000D 04	3.3854D 00	8.0000D 04	3.3603D 00	1.0000D 05	3.3633D 00
2.0000D 05	3.5119D 00	3.0000D 05	3.5201D 00	4.0000D 05	3.4797D 00
5.0000D 05	3.4278D 00	6.0000D 05	3.3825D 00	7.0000D 05	3.3450D 00
8.0000D 05	3.3207D 00	1.0000D 06	3.3164D 00	1.2500D 06	3.3687D 00
1.5000D 06	3.4338D 00	1.7500D 06	3.4652D 00	2.0000D 06	3.4525D 00
2.5000D 06	3.3441D 00	3.0000D 06	3.2101D 00	4.0000D 06	3.0136D 00
5.0000D 06	2.8942D 00	6.0000D 06	2.8347D 00	7.0000D 06	2.8354D 00
8.0000D 06	2.8576D 00	1.0000D 07	2.9083D 00	1.2000D 07	2.7824D 00
1.4000D 07	2.7027D 00	1.6000D 07	2.6693D 00	1.8000D 07	2.6430D 00
2.0000D 07	2.6066D 00	0.0	0.0	0.0	0.0

COUPLED CHANNEL CALCULATIONS FOR PLUTONIUM 240 (CH,LAGRANGE,77)

NEUTRON SHAPE ELASTIC SCATTERING CROSS SECTIONS

E	S(E)	E	S(E)	E	S(E)
1.0000D 03	1.1116D 01	5.0000D 03	1.0913D 01	1.0000D 04	1.0733D 01
2.0000D 04	1.0439D 01	3.0000D 04	1.0188D 01	4.0000D 04	9.9603D 00
6.0000D 04	9.4473D 00	8.0000D 04	9.0862D 00	1.0000D 05	8.7577D 00
2.0000D 05	7.4380D 00	3.0000D 05	6.4615D 00	4.0000D 05	5.6999D 00
5.0000D 05	5.0929D 00	6.0000D 05	4.6057D 00	7.0000D 05	4.2150D 00
8.0000D 05	3.9038D 00	1.0000D 06	3.4711D 00	1.2500D 06	3.1981D 00
1.5000D 06	3.1379D 00	1.7500D 06	3.2213D 00	2.0000D 06	3.3896D 00
2.5000D 06	3.8046D 00	3.0000D 06	4.1542D 00	4.0000D 06	4.4426D 00
5.0000D 06	4.2834D 00	6.0000D 06	3.8787D 00	7.0000D 06	3.4219D 00
8.0000D 06	3.0360D 00	1.0000D 07	2.6414D 00	1.2000D 07	2.6039D 00
1.4000D 07	2.7914D 00	1.6000D 07	3.0944D 00	1.8000D 07	3.3901D 00
2.0000D 07	3.5928D 00	0.0	0.0	0.0	0.0

COUPLED CHANNEL CALCULATIONS FOR PLUTONIUM 240 (CH.LAGRANGE.77)

NEUTRON DIRECT INELASTIC FIRST EXCITED LEVEL

E	S(E)	E	S(E)	E	S(E)
6.0000D 04	2.0474D-03	8.0000D 04	6.3660D-03	1.0000D 05	1.1904D-02
2.0000D 05	3.9442D-02	3.0000D 05	6.5718D-02	4.0000D 05	8.8047D-02
5.0000D 05	1.0858D-01	6.0000D 05	1.2906D-01	7.0000D 05	1.5030D-01
8.0000D 05	1.7263D-01	1.0000D 06	2.1991D-01	1.2500D 06	2.7917D-01
1.5000D 06	3.3186D-01	1.7500D 06	3.7352D-01	2.0000D 06	4.0254D-01
2.5000D 06	4.2569D-01	3.0000D 06	4.1753D-01	4.0000D 06	3.6999D-01
5.0000D 06	3.2271D-01	6.0000D 06	2.9266D-01	7.0000D 06	2.7748D-01
8.0000D 06	2.6678D-01	1.0000D 07	2.4912D-01	1.2000D 07	2.3880D-01
1.4000D 07	2.2481D-01	1.6000D 07	2.1646D-01	1.8000D 07	2.1032D-01
2.0000D 07	2.0389D-01	0.0	0.0	0.0	0.0

COUPLED CHANNEL CALCULATIONS FOR PLUTONIUM 240 (CH,LAGRANGE,77)

NEUTRON DIRECT INELASTIC SECOND EXCITED LEVEL

E	S(E)	E	S(E)	E	S(E)
2.0000D 05	7.7006D-05	3.0000D 05	1.2762D-03	4.0000D 05	4.4529D-03
5.0000D 05	1.0095D-02	6.0000D 05	1.8164D-02	7.0000D 05	2.8107D-02
8.0000D 05	3.9277D-02	1.0000D 06	6.2688D-02	1.2500D 06	8.8883D-02
1.5000D 06	1.0868D-01	1.7500D 06	1.2169D-01	2.0000D 06	1.2893D-01
2.5000D 06	1.3263D-01	3.0000D 06	1.3033D-01	4.0000D 06	1.1997D-01
5.0000D 06	1.0735D-01	6.0000D 06	9.7091D-02	7.0000D 06	8.7432D-02
8.0000D 06	7.6538D-02	1.0000D 07	5.7392D-02	1.2000D 07	5.1669D-02
1.4000D 07	4.5277D-02	1.6000D 07	3.9808D-02	1.8000D 07	3.6066D-02
2.0000D 07	3.3107D-02	0.0	0.0	0.0	0.0

COUPLED CHANNEL CALCULATIONS FOR PLUTONIUM 240

LEGENDRE COEFFICIENTS FOR SHAPE ELASTIC
THE LEGENDRE COEFFICIENTS ARE IN THE ORDER 1.2..

```
ELAB= 1.0000E 03  LMAX=    3
                   9.8409D-03 -9.6910D-10  3.7528D-06  0.0

ELAB= 5.0000E 03  LMAX=    3
                   5.2381D-02  2.9809D-04  4.5489D-06  0.0

ELAB= 1.0000E 04  LMAX=    3
                   1.0843D-01  1.1593D-03  7.0014D-06  0.0

ELAB= 2.0000E 04  LMAX=    3
                   2.2401D-01  4.5377D-03  3.4620D-05  0.0

ELAB= 3.0000E 04  LMAX=    3
                   3.4012D-01  9.9587D-03  1.1242D-04  0.0

ELAB= 4.0000E 04  LMAX=    3
                   4.5444D-01  1.7235D-02  2.7470D-04  0.0

ELAB= 6.0000E 04  LMAX=    3
                   6.3892D-01  3.4833D-02  8.2553D-04  0.0

ELAB= 8.0000E 04  LMAX=    3
                   8.3213D-01  5.8527D-02  1.8725D-03  0.0

ELAB= 1.0000E 05  LMAX=    3
                   1.0091D 00  8.6416D-02  3.4843D-03  0.0

ELAB= 2.0000E 05  LMAX=    3
                   1.6871D 00  2.6351D-01  2.2071D-02  0.0

ELAB= 3.0000E 05  LMAX=    5
                   2.0405D 00  4.3834D-01  6.3140D-02  6.6787D-03

ELAB= 4.0000E 05  LMAX=    5
                   2.2067D 00  5.8775D-01  1.2253D-01  1.7506D-02

ELAB= 5.0000E 05  LMAX=    5
                   2.2491D 00  7.0274D-01  1.9754D-01  3.5774D-02

ELAB= 6.0000E 05  LMAX=    6
                   2.2254D 00  7.8837D-01  2.8342D-01  6.2439D-02

ELAB= 7.0000E 05  LMAX=    6
                   2.1680D 00  8.5300D-01  3.7643D-01  9.8050D-02

ELAB= 8.0000E 05  LMAX=    6
                   2.0973D 00  9.0527D-01  4.7278D-01  1.4278D-01
```

```
(CH,LAGRANGE,77)

.6 AND NEXT LINE 7.8.:.:.....:.. 12

 0.0          0.0

 0.0          0.0

 0.0          0.0

 0.0          0.0

 0.0          0.0

 0.0          0.0

 0.0          0.0

 0.0          0.0

 0.0          0.0

 0.0          0.0

-4.9132D-05   0.0

-8.2718D-05   0.0

 3.1439D-05   0.0

 7.7192D-04   5.0474D-04

 2.5449D-03   1.1992D-03

 6.2632D-03   2.4923D-03
```

COUPLED CHANNEL CALCULATIONS FOR PLUTONIUM 240

LEGENDRE COEFFICIENTS FOR SHAPE ELASTIC
THE LEGENDRE COEFFICIENTS ARE IN THE ORDER 1.2...

```
ELAB= 1.0000E 06  LMAX=    8
                  1.9649D 00  1.0002D 00  6.6367D-01  2.5861D-01
                  7.2374D-04  7.9100D-05  0.0         0.0

ELAB= 1.2500E 06  LMAX=    8
                  1.8844D 00  1.1425D 00  8.7912D-01  4.4311D-01
                  2.7768D-03  3.2067D-04  0.0         0.0

ELAB= 1.5000E 06  LMAX=    9
                  1.9335D 00  1.3278D 00  1.0622D 00  6.5069D-01
                  7.9135D-03  1.1021D-03  1.0667D-04  0.0

ELAB= 1.7500E 06  LMAX=    9
                  2.0998D 00  1.5446D 00  1.2249D 00  8.5746D-01
                  1.7986D-02  2.9276D-03  3.2953D-04  0.0

ELAB= 2.0000E 06  LMAX=    9
                  2.3326D 00  1.7754D 00  1.3828D 00  1.0484D 00
                  3.4604D-02  6.5132D-03  8.4727D-04  0.0

ELAB= 2.5000E 06  LMAX=   11
                  2.8622D 00  2.2294D 00  1.7070D 00  1.3684D 00
                  9.0414D-02  2.1823D-02  3.8335D-03  4.8677D-04

ELAB= 3.0000E 06  LMAX=   12
                  3.3077D 00  2.6183D 00  2.0194D 00  1.6163D 00
                  1.7212D-01  5.2350D-02  1.1639D-02  1.8177D-03

ELAB= 4.0000E 06  LMAX=   14
                  8.4213D-01  6.9291D-01  5.5397D-01  4.3589D-01
                  8.1191D-02  3.5135D-02  1.1381D-02  2.6138D-03
                  9.1626D-06  1.1139D-06  0.0         0.0

ELAB= 5.0000E 06  LMAX=   15
                  8.5878D-01  7.2752D-01  6.0179D-01  4.7634D-01
                  1.1875D-01  6.4899D-02  2.8561D-02  9.0142D-03
                  7.1515D-05  1.0718D-05  9.2407D-07  0.0

ELAB= 6.0000E 06  LMAX=   16
                  8.6219D-01  7.4220D-01  6.3074D-01  5.1071D-01
                  1.5560D-01  9.8649D-02  5.5425D-02  2.2727D-02
                  3.7918D-04  7.5656D-05  1.4006D-05  2.6249D-06

ELAB= 7.0000E 06  LMAX=   16
                  8.6097D-01  7.4539D-01  6.4688D-01  5.3872D-01
                  1.9842D-01  1.3742D-01  9.2106D-02  4.7181D-02
                  1.4674D-03  3.4512D-04  7.0102D-05  1.1945D-05
```

```
(CH.LAGRANGE.77)

..6 AND NEXT LINE 7.8.....  12

 2.3573D-02  8.4416D-03
 0.0         0.0

 7.5265D-02  2.5495D-02
 0.0         0.0

 1.6903D-01  5.7752D-02
 0.0         0.0

 2.9944D-01  1.0659D-01
 0.0         0.0

 4.5110D-01  1.7051D-01
 0.0         0.0

 7.5826D-01  3.2882D-01
 5.6481D-05  0.0

 1.0163D 00  4.9695D-01
 2.7095D-04  3.2440D-05

 3.0461D-01  1.7345D-01
 5.1337D-04  7.3076D-05
 0.0         0.0

 3.4908D-01  2.1718D-01
 2.2637D-03  4.5591D-04
 0.0         0.0

 3.8616D-01  2.5931D-01
 7.2784D-03  1.8831D-03
 0.0         0.0

 4.2100D-01  3.0365D-01
 1.8900D-02  5.0928D-03
 0.0         0.0
```

COUPLED CHANNEL CALCULATIONS FOR PLUTONIUM 240

LEGENDRE COEFFICIENTS FOR SHAPE ELASTIC
THE LEGENDRE COEFFICIENTS ARE IN THE ORDER 1.2..

ELAB= 8.0000E 06	LMAX= 17			
	8.5621D-01	7.3991D-01	6.4874D-01	5.5441D-01
	2.4531D-01	1.7995D-01	1.3525D-01	8.3160D-02
	4.4159D-03	1.2120D-03	2.7898D-04	5.8105D-05
ELAB= 1.0000E 07	LMAX= 18			
	8.5456D-01	7.2298D-01	6.2796D-01	5.5168D-01
	3.2851D-01	2.6585D-01	2.2358D-01	1.7356D-01
	2.3427D-02	8.0438D-03	2.4247D-03	6.4621D-04
ELAB= 1.2000E 07	LMAX= 20			
	8.6356D-01	7.2003D-01	6.0965D-01	5.3276D-01
	3.6367D-01	3.1621D-01	2.7589D-01	2.3523D-01
	5.3310D-02	2.2962D-02	8.7296D-03	2.8663D-03
	4.9535D-05	9.4633D-06	0.0	0.0
ELAB= 1.4000E 07	LMAX= 21			
	8.8530D-01	7.5258D-01	6.4057D-01	5.5537D-01
	3.8988D-01	3.4893D-01	3.0819D-01	2.6784D-01
	8.5451D-02	4.4394D-02	2.0540D-02	8.2189D-03
	2.6054D-04	7.4137D-05	1.6399D-05	0.0
ELAB= 1.6000E 07	LMAX= 22			
	9.0964D-01	7.9928D-01	6.9683D-01	6.0770D-01
	4.2193D-01	3.7687D-01	3.3297D-01	2.8826D-01
	1.1452D-01	6.8073D-02	3.6824D-02	1.7543D-02
	9.1422D-04	2.9357D-04	8.5757D-05	2.1162D-05
ELAB= 1.8000E 07	LMAX= 23			
	9.2730D-01	8.3736D-01	7.4915D-01	6.6419D-01
	4.5957D-01	4.0673D-01	3.5701D-01	3.0716D-01
	1.3813D-01	8.0337D-02	5.4193D-02	2.9935D-02
	2.4323D-03	8.8379D-04	2.6898D-04	8.1993D-05
ELAB= 2.0000E 07	LMAX= 24			
	9.3717D-01	8.6092D-01	7.8619D-01	7.1017D-01
	4.9791D-01	4.3794D-01	3.8164D-01	3.2678D-01
	1.5725D-01	1.0706D-01	7.0023D-02	4.3411D-02
	5.3065D-03	2.1535D-03	7.3480D-04	2.4803D-04

(CH,LAGRANGE,77)

..6 AND NEXT LINE 7.8.....12

4.5003D-01	3.4473D-01
4.0110D-02	1.5018D-02
1.0265D-05	0.0

4.7807D-01	4.0175D-01
1.0885D-01	5.7066D-02
1.5389D-04	3.3249D-05

4.7046D-01	4.1510D-01
1.7359D-01	1.0669D-01
8.1347D-04	2.2085D-04
0.0	0.0

4.8840D-01	4.3605D-01
2.1328D-01	1.4633D-01
2.8889D-03	9.5178D-04
0.0	0.0

5.3316D-01	4.7313D-01
2.3723D-01	1.7551D-01
7.4124D-03	2.8505D-03
0.0	0.0

5.8656D-01	5.1872D-01
2.5520D-01	1.9745D-01
1.4839D-02	6.5355D-03
1.9669D-05	0.0

6.3469D-01	5.6325D-01
2.7161D-01	2.1498D-01
2.4600D-02	1.2313D-02
8.2177D-05	2.2430D-05

COUPLED CHANNEL CALCULATIONS FOR PLUTONIUM 240 (CH,LAGRANGE.77)

LEGENDRE COEFFICIENTS FOR DIRECT INELASTIC (1 LEVEL)
THE LEGENDRE COEFFICIENTS ARE IN THE ORDER 1.2...6 AND NEXT LINE 7.8.....12

```
ELAB= 6.0000E 04  LMAX=    3
                   6.3074D-04  9.0151D-05 -3.4512D-06  0.0          0.0          0.0

ELAB= 8.0000E 04  LMAX=    3
                   1.8528D-03  2.7967D-04 -2.0330D-05  0.0          0.0          0.0

ELAB= 1.0000E 05  LMAX=    3
                   3.3906D-03  4.9858D-04 -5.5997D-05  0.0          0.0          0.0

ELAB= 2.0000E 05  LMAX=    3
                   1.1753D-02  1.1738D-03 -5.4002D-04  0.0          0.0          0.0

ELAB= 3.0000E 05  LMAX=    5
                   1.7525D-02 -6.5785D-04 -1.7528D-03  2.8228D-04 -7.0400D-06  0.0

ELAB= 4.0000E 05  LMAX=    5
                   2.0931D-02 -2.7370D-03 -3.3401D-03  7.3166D-04 -2.0301D-05  0.0

ELAB= 5.0000E 05  LMAX=    5
                   2.2363D-02 -5.0506D-03 -5.2323D-03  1.3951D-03 -3.9240D-05  0.0

ELAB= 6.0000E 05  LMAX=    6
                   2.2527D-02 -7.3457D-03 -7.0678D-03  1.7897D-03 -6.6504D-05  8.4217D-05

ELAP= 7.0000E 05  LMAX=    6
                   2.1922D-02 -9.2824D-03 -9.2816D-03  2.2425D-03 -6.9819D-05  1.8652D-04

ELAB= 8.0000E 05  LMAX=    6
                   2.0900D-02 -1.0855D-02 -1.1532D-02  2.4308D-03 -4.5108D-05  3.5865D-04

ELAB= 1.0000E 06  LMAX=    8
                   1.8478D-02 -1.2958D-02 -1.5639D-02  1.5415D-03  2.6198D-04  9.6719D-04
                  -3.5286D-05  1.3738D-05  0.0          0.0          0.0          0.0

ELAB= 1.2500E 06  LMAX=    8
                   1.6083D-02 -1.4226D-02 -1.9440D-02 -2.3116D-03  1.0742D-03  2.2940D-03
                  -1.1324D-04  6.2849D-05  0.0          0.0          0.0          0.0

ELAB= 1.5000E 06  LMAX=    9
                   1.5199D-02 -1.4582D-02 -2.1761D-02 -8.2290D-03  2.6276D-03  3.8741D-03
                  -1.3491D-04  2.2619D-04 -1.3018D-05  0.0          0.0          0.0

ELAB= 1.7500E 06  LMAX=    9
                   1.6818D-02 -1.3949D-02 -2.3014D-02 -1.3233D-02  5.3144D-03  5.2025D-03
                  -2.4359D-04  5.4649D-04 -3.9066D-05  0.0          0.0          0.0

ELAB= 2.0000E 06  LMAX=    9
                   2.1877D-02 -1.1342D-02 -2.2628D-02 -1.4911D-02  8.9841D-03  5.5953D-03
                  -1.2894D-04  1.0762D-03 -9.0879D-05  0.0          0.0          0.0
```

COUPLED CHANNEL CALCULATIONS FOR PLUTONIUM 240 (CH,LAGRANGE,77)

LEGENDRE COEFFICIENTS FOR DIRECT INELASTIC (1 LEVEL)
THE LEGENDRE COEFFICIENTS ARE IN THE ORDER 1.2...6 AND NEXT LINE 7.8..... 12

```
ELAB= 2.5000E 06  LMAX=   11
                   4.0676D-02  5.5971D-04 -1.4297D-02 -8.0936D-03  1.6981D-02  3.1811D-03
                   9.5393D-04  2.3800D-03 -2.5002D-04  1.8142D-04 -3.5395D-06  0.0

ELAB= 3.0000E 06  LMAX=   12
                   6.0322D-02  1.4496D-02  1.8249D-04  2.6037D-03  2.2912D-02 -9.7742D-04
                   2.2024D-03  3.2542D-03 -3.3647D-04  5.8155D-04 -1.7091D-05  1.1923D-05

ELAB= 4.0000E 06  LMAX=   14
                   2.0746D-01  7.5718D-02  4.4316D-02  3.3031D-02  6.6134D-02 -1.1334D-02
                  -1.1186D-03  3.8244D-04  9.7460D-04  6.3944D-03 -4.2085D-04  3.4095D-04
                   1.5201D-05  4.1926D-06  0.0         0.0         0.0         0.0

ELAB= 5.0000E 06  LMAX=   15
                   2.3680D-01  8.3557D-02  3.4131D-02  3.3289D-02  4.6142D-02 -7.8239D-03
                  -2.1838D-02 -2.4672D-02  7.6351D-03  1.3142D-02 -1.9618D-03  2.0664D-03
                   6.7037D-05  4.5245D-05  6.5559D-06  0.0         0.0         0.0

ELAB= 6.0000E 06  LMAX=   16
                   2.6303D-01  7.8249D-02  7.2375D-03  1.4837D-02  1.2005D-02 -1.4659D-02
                  -3.5335D-02 -4.1280D-02  1.4252D-02  1.0340D-02 -3.7247D-03  6.4039D-03
                   9.8071D-05  2.3541D-04  4.6002D-05  6.9653D-06  0.0         0.0

ELAB= 7.0000E 06  LMAX=   16
                   2.8495D-01  7.6755D-02 -3.2230D-03  1.2393D-03 -5.6540D-03 -1.9375D-02
                  -2.9973D-02 -4.1732D-02  7.7994D-03 -4.8343D-03 -2.1640D-03  1.3153D-02
                  -1.5251D-04  8.1319D-04  2.0820D-04  3.3395D-05  0.0         0.0

ELAB= 8.0000E 06  LMAX=   17
                   3.0285D-01  8.1647D-02 -3.2346D-03 -5.8838D-03 -1.3584D-02 -2.3720D-02
                  -2.7050D-02 -4.4630D-02 -7.2993D-03 -1.7968D-02  3.8695D-03  1.8187D-02
                  -8.3060D-04  2.1487D-03  6.4592D-04  1.3576D-04  4.1102D-05  0.0

ELAB= 1.0000E 07  LMAX=   18
                   3.8705D-01  1.1157D-01  1.9191D-02 -1.3251D-02 -2.8751D-02 -4.1595D-02
                  -4.2980D-02 -5.6408D-02 -3.1546D-02 -1.5612D-02  5.0537D-03  1.0981D-02
                   1.1248D-02  8.7840D-03  1.5588D-03  2.1198D-03  3.1526D-04  1.2937D-04

ELAB= 1.2000E 07  LMAX=   20
                   4.4649D-01  1.6634D-01  5.2771D-02  9.8956D-03 -1.2302D-02 -2.9726D-02
                  -3.4322D-02 -3.9973D-02 -2.4570D-02 -8.0618D-03  1.0730D-02  8.7689D-03
                   1.2330D-02  7.0499D-03  4.7960D-03  6.7993D-03  8.7523D-04  7.7302D-04
                   1.5935D-04  4.7505D-05  0.0         0.0         0.0         0.0

ELAB= 1.4000E 07  LMAX=   21
                   4.8605D-01  2.0766D-01  8.0382D-02  4.0247D-02  1.3260D-02 -2.6555D-03
                  -9.5583D-03 -1.5121D-02 -6.0775D-03  2.2459D-03  1.6209D-02  6.1963D-03
                   1.7892D-03 -1.4019D-03  1.0004D-02  1.1156D-02  1.6346D-03  2.9305D-03
                   5.8777D-04  2.9553D-04  7.1256D-05  0.0         0.0         0.0
```

COUPLED CHANNEL CALCULATIONS FOR PLUTONIUM 240 (CH,LAGRANGE.77)

LEGENDRE COEFFICIENTS FOR DIRECT INELASTIC (1 LEVEL)
THE LEGENDRE COEFFICIENTS ARE IN THE ORDER 1.2...6 AND NEXT LINE 7.8..... 12

```
ELAB= 1.6000E 07  LMAX=   22
                  5.1132D-01  2.4291D-01  1.0809D-01  6.4818D-02  3.2958D-02  2.1080D-02
                  1.0305D-02  4.5280D-03  7.0931D-03  8.7397D-03  1.6462D-02  7.6335D-03
                  2.0473D-03 -2.9961D-03  1.1422D-02  8.9264D-03  3.5629D-03  7.7637D-03
                  1.6303D-03  1.1551D-03  3.7190D-04  1.1464D-04  0.0         0.0

ELAB= 1.8000E 07  LMAX=   23
                  5.2794D-01  2.7261D-01  1.3357D-01  8.5473D-02  5.3336D-02  4.3732D-02
                  3.2709D-02  2.7398D-02  2.5573D-02  2.3223D-02  2.5769D-02  1.5691D-02
                  1.0467D-02 -3.6096D-03  2.0414D-03 -6.5599D-04  7.5643D-03  1.3926D-02
                  3.4839D-03  3.5880D-03  1.1704D-03  5.0433D-04  1.3850D-04  0.0

ELAB= 2.0000E 07  LMAX=   24
                  5.4115D-01  2.9256D-01  1.4783D-01  9.4154D-02  6.1541D-02  5.2971D-02
                  4.5478D-02  4.0961D-02  3.8593D-02  3.2220D-02  3.0921D-02  1.6088D-02
                  8.5959D-03 -9.3972D-03 -1.0184D-02 -1.1018D-02  8.8843D-03  1.5377D-02
                  5.8789D-03  8.1383D-03  2.8121D-03  1.3511D-03  4.9059D-04  1.5014D-04
```

COUPLED CHANNEL CALCULATIONS FOR PLUTONIUM 240 (CH.LAGRANGE.77)

LEGENDRE COEFFICIENTS FOR DIRECT INELASTIC (2 LEVEL)
THE LEGENDRE COEFFICIENTS ARE IN THE ORDER 1.2...6 AND NEXT LINE 7.8.....12

```
ELAB= 2.0000E 05  LMAX=    3
                   2.2774D-05  1.0368D-05  1.1293D-06  0.0         0.0         0.0

ELAB= 3.0000E 05  LMAX=    5
                   5.6271D-04  2.8188D-04  2.3630D-05  1.6460D-06 -2.5592D-07  0.0

ELAB= 4.0000E 05  LMAX=    5
                   2.1099D-03  9.7886D-04  6.9346D-05 -1.5008D-07 -1.2489D-06  0.0

ELAB= 5.0000E 05  LMAX=    5
                   4.8738D-03  2.0995D-03  1.0887D-04 -1.5536D-05 -3.0641D-06  0.0

ELAB= 6.0000E 05  LMAX=    6
                   8.8048D-03  3.3721D-03  1.8196D-06 -7.0934D-05 -3.9445D-06  1.9325D-06

ELAB= 7.0000E 05  LMAX=    6
                   1.3370D-02  4.6026D-03 -2.2990D-04 -1.4735D-04  5.8450D-07  4.2213D-06

ELAB= 8.0000E 05  LMAX=    6
                   1.8172D-02  5.4738D-03 -6.5728D-04 -2.4551D-04  1.5549D-05  7.6211D-06

ELAB= 1.0000E 06  LMAX=    8
                   2.6931D-02  5.2557D-03 -2.1997D-03 -4.5722D-04  1.4872D-04  1.2640D-05
                  -6.6586D-06  6.5012D-07  0.0         0.0         0.0         0.0

ELAB= 1.2500E 06  LMAX=    8
                   3.3731D-02  1.3350D-03 -4.3534D-03 -2.6321D-04  4.1532D-04 -3.8131D-06
                  -1.9499D-05  3.0077D-06  0.0         0.0         0.0         0.0

ELAB= 1.5000E 06  LMAX=    9
                   3.6083D-02 -4.1167D-03 -5.2376D-03  7.9981D-04  7.2141D-04 -9.4281D-05
                  -2.7924D-05  9.5214D-06 -1.9215D-06  0.0         0.0         0.0

ELAB= 1.7500E 06  LMAX=    9
                   3.6151D-02 -7.8543D-03 -4.2504D-03  2.3763D-03  8.4101D-04 -2.4769D-04
                  -2.2697D-05  1.8798D-05 -5.7279D-06  0.0         0.0         0.0

ELAB= 2.0000E 06  LMAX=    9
                   3.5592D-02 -8.9258D-03 -1.8771D-03  3.8868D-03  6.6969D-04 -4.2756D-04
                   1.1591D-05  2.4561D-05 -1.1160D-05  0.0         0.0         0.0

ELAB= 2.5000E 06  LMAX=   11
                   3.4406D-02 -6.8088D-03  2.8891D-03  4.9625D-03 -3.0887D-04 -5.6507D-04
                   1.6884D-04 -1.8295D-05 -3.2631D-05  1.1753D-05 -7.7749D-07  0.0

ELAB= 3.0000E 06  LMAX=   12
                   3.3436D-02 -4.1077D-03  4.9057D-03  3.5455D-03 -1.1649D-03 -1.3232D-04
                   2.9541D-04 -1.9517D-04 -5.1798D-05  3.5960D-05 -3.2300D-06  1.1020D-06
```

COUPLED CHANNEL CALCULATIONS FOR PLUTONIUM 240 (CH,LAGRANGE,77)

LEGENDRE COEFFICIENTS FOR DIRECT INELASTIC (2 LEVEL)
THE LEGENDRE COEFFICIENTS ARE IN THE ORDER 1.2....6 AND NEXT LINE 7.8..... 12

```
ELAB= 4.0000E 06  LMAX=   14
                   2.58900-01 -3.17740-03  3.91860-02 -3.54260-03 -5.31050-03  7.27620-03
                  -4.02420-03 -5.16430-03  7.58680-04  6.57690-04 -2.18890-04  1.12020-04
                   2.19750-06  2.13210-06  0.0         0.0        0.0         0.0

ELAB= 5.0000E 06  LMAX=   15
                   2.53640-01  1.54850-02  3.17940-02 -2.87880-02 -9.93400-04 -3.90190-03
                  -1.73030-02  2.56760-03  4.65910-03 -1.41370-03 -6.13390-04  5.77930-04
                  -2.26740-05  1.40220-05  1.17580-06  0.0         0.0         0.0

ELAB= 6.0000E 06  LMAX=   16
                   2.44630-01  3.69720-02  3.11130-02 -3.82600-02  3.00010-03 -1.49110-02
                  -1.89900-02  2.31840-02  5.29680-03 -7.56510-03 -2.05490-04  1.45830-03
                  -1.99330-04  6.32570-05  7.05330-06  1.62110-06  0.0         0.0

ELAB= 7.0000E 06  LMAX=   16
                   2.44460-01  6.38690-02  3.91980-02 -2.67060-02  1.56910-02 -9.88650-03
                  -1.04210-02  3.05800-02 -1.82240-03 -1.15500-02  2.83890-03  2.00800-03
                  -7.43330-04  1.66550-04  1.39960-05  7.52100-06  0.0         0.0

ELAB= 8.0000E 06  LMAX=   17
                   2.60910-01  9.11800-02  4.32250-02 -1.58680-02  2.23520-02 -8.38630-03
                  -7.54340-03  1.73780-02 -1.20830-02 -6.00180-03  7.99770-03  9.37330-04
                  -1.68250-03  3.46430-04  2.31030-05  2.49020-05  1.18840-05  0.0

ELAB= 1.0000E 07  LMAX=   18
                   3.70010-01  1.36810-01  4.69960-02 -3.42920-03  5.97820-03 -1.57280-02
                  -7.82960-03 -4.09490-04  3.64820-03  1.57650-02  2.50900-03 -2.61260-03
                   1.66190-03 -1.48840-03 -4.92700-04  6.92610-04  4.85400-05  6.55680-05

ELAB= 1.2000E 07  LMAX=   20
                   4.17160-01  1.67360-01  6.86970-02  1.48710-02  1.26690-02 -1.04160-02
                   4.24350-03  3.23350-04  9.65030-03  2.15270-02  5.47090-03  7.30200-03
                  -5.05330-04 -8.40540-03  1.72500-04  1.43410-03 -1.37170-04  3.46590-04
                   3.96260-05  2.11260-05  0.0         0.0        0.0         0.0

ELAB= 1.4000E 07  LMAX=   21
                   4.32040-01  2.00130-01  9.64220-02  2.97800-02  2.34700-02 -4.18660-03
                   1.11900-02  1.51460-03  9.76660-03  1.71550-02  5.50550-03  1.06290-02
                  -8.17360-03 -8.34560-03  4.05350-03 -1.00700-03 -9.48450-04  1.04370-03
                  -1.93730-05  1.13210-04  2.73850-05  0.0         0.0         0.0

ELAB= 1.6000E 07  LMAX=   22
                   4.42390-01  2.44380-01  1.23760-01  4.84750-02  3.64630-02  6.55950-04
                   1.49120-02 -1.39490-03  7.26190-03  8.08150-03  1.88040-03  8.76500-03
                  -8.63380-03  5.22940-03  4.88990-03 -9.06780-03 -8.57900-04  1.84120-03
                  -4.98170-04  4.30410-04  1.36330-04  6.22410-05  0.0         0.0
```

COUPLED CHANNEL CALCULATIONS FOR PLUTONIUM 240 (CH,LAGRANGE.77)

LEGENDRE COEFFICIENTS FOR DIRECT INELASTIC (2 LEVEL)
THE LEGENDRE COEFFICIENTS ARE IN THE ORDER 1.2...6 AND NEXT LINE 7.8..... 12

```
ELAB= 1.8000E 07  LMAX=   23
                   4.65350-01  2.88460-01  1.43870-01  6.88190-02  4.74550-02  8.80520-03
                   1.96250-02 -2.20500-04  1.14280-02  7.30210-03  6.01610-03  1.54170-02
                  -3.40190-03  1.12070-02 -4.48530-03 -1.46580-02  1.98970-03  8.09500-05
                  -1.67790-03  1.29570-03  3.71060-04  2.83280-04  8.16460-05  0.0

ELAB= 2.0000E 07  LMAX=   24
                   4.84050-01  3.17360-01  1.60500-01  8.68350-02  5.24730-02  1.21760-02
                   1.71220-02 -3.70590-03  6.71050-03  1.44210-03  4.37990-04  1.12680-02
                  -6.67910-03  7.40110-03 -8.79550-03 -7.59350-03  4.37260-03 -6.06720-03
                  -3.24050-03  2.52180-03  6.09860-04  6.67860-04  2.60720-04  9.00580-05
```

APPENDIX 1B

RESULTS OF COUPLED CHANNEL CALCULATIONS FOR ^{240}Pu :

NEUTRON TRANSMISSION COEFFICIENTS FOR THE GROUND STATE.

NEUTRON TRANSMISSION COEFFICIENTS FOR PLUTONIUM 240

THE COEFFICIENTS ARE IN THE ORDER (L,J): (0,1/2),(1,1/2),(1,3/2),(2,3/2),(2,5/2),(3,5/2),(3,7/2), ...

E= 0.10000E-02(MEV) LMAX= 3 JMAX= 5/2
0.20014E-01 0.10563E-03 0.14368E-03 0.40263E-07 0.26576E-07 0.49190E-11

E= 0.50000E-02(MEV) LMAX= 3 JMAX= 5/2
0.44174E-01 0.11727E-02 0.15944E-02 0.22361E-05 0.14785E-05 0.13737E-08

E= 0.10000E-01(MEV) LMAX= 3 JMAX= 5/2
0.61849E-01 0.32865E-02 0.44651E-02 0.12546E-04 0.83128E-05 0.15525E-07

E= 0.20000E-01(MEV) LMAX= 3 JMAX= 5/2
0.86211E-01 0.91207E-02 0.12370E-01 0.69805E-04 0.46452E-04 0.17527E-06

E= 0.30000E-01(MEV) LMAX= 3 JMAX= 5/2
0.10440E 00 0.16433E-01 0.22244E-01 0.18918E-03 0.12644E-03 0.72297E-06

E= 0.40000E-01(MEV) LMAX= 3 JMAX= 5/2
0.11938E 00 0.24806E-01 0.33504E-01 0.38187E-03 0.25634E-03 0.19748E-05

E= 0.60000E-01(MEV) LMAX= 3 JMAX= 5/2
0.14513E 00 0.42595E-01 0.57416E-01 0.10023E-02 0.70961E-03 0.78201E-05

E= 0.80000E-01(MEV) LMAX= 3 JMAX= 5/2
0.16540E 00 0.62950E-01 0.84627E-01 0.19902E-02 0.14223E-02 0.21312E-04

E= 0.10000E 00(MEV) LMAX= 3 JMAX= 5/2
0.18281E 00 0.84463E-01 0.11321E 00 0.33617E-02 0.24254E-02 0.46361E-04

E= 0.20000E 00(MEV) LMAX= 3 JMAX= 5/2
0.24917E 00 0.20244E 00 0.26891E 00 0.16179E-01 0.12349E-01 0.57180E-03

E= 0.30000E 00(MEV) LMAX= 4 JMAX= 7/2
0.29610E 00 0.31024E 00 0.40238E 00 0.37482E-01 0.30015E-01 0.23487E-02 0.28166E-02 0.33027E-04

E= 0.40000E 00(MEV) LMAX= 4 JMAX= 7/2
0.33386E 00 0.40411E 00 0.51103E 00 0.64757E-01 0.54189E-01 0.63149E-02 0.75327E-02 0.11520E-03

E= 0.50000E 00(MEV) LMAX= 4 JMAX= 7/2
0.36573E 00 0.48357E 00 0.59629E 00 0.95527E-01 0.83100E-01 0.13468E-01 0.16021E-01 0.30104E-03

E= 0.60000E 00(MEV) LMAX= 5 JMAX= 9/2
0.39318E 00 0.54963E 00 0.66136E 00 0.12783E 00 0.11495E 00 0.24805E-01 0.29443E-01 0.65528E-03 0.69315E-03 0.23898E-04

E= 0.70000E 00(MEV) LMAX= 5 JMAX= 9/2
0.41699E 00 0.60362E 00 0.70941E 00 0.16025E 00 0.14813E 00 0.41241E-01 0.48840E-01 0.12573E-02 0.13630E-02 0.55470E-04

E= 0.80000E 00(MEV) LMAX= 5 JMAX= 9/2
0.43768E 00 0.64693E 00 0.74333E 00 0.19184E 00 0.18137E 00 0.63515E-01 0.75013E-01 0.21990E-02 0.24379E-02 0.11489E-03

NEUTRON TRANSMISSION COEFFICIENTS FOR PLUTONIUM 240:

THE COEFFICIENTS ARE IN THE ORDER (L,J): (0,1/2),(1,1/2),(1,3/2),(2,3/2),(2,5/2),(3,5/2),(3,7/2), ...

E= 0.10000E 01(MEV) LMAX= 6 JMAX= 11/2
0.47106E 00 0.70706E 00 0.77917E 00 0.25047E 00 0.24451E 00 0.12691E 00 0.14896E 00 0.55188E-02 0.63590E-02 0.38615E-03
0.71168E-03 0.92106E-05

E= 0.12500E 01(MEV) LMAX= 6 JMAX= 11/2
0.50065E 00 0.74658E 00 0.78751E 00 0.31328E 00 0.31231E 00 0.23707E 00 0.27668E 00 0.13517E-01 0.16175E-01 0.12855E-02
0.21469E-02 0.39718E-04

E= 0.15000E 01(MEV) LMAX= 7 JMAX= 13/2
0.51993E 00 0.76295E 00 0.77982E 00 0.36463E 00 0.36544E 00 0.36319E 00 0.42316E 00 0.27342E-01 0.33606E-01 0.33941E-02
0.51159E-02 0.13097E-03 0.14393E-03 0.38960E-05

E= 0.17500E 01(MEV) LMAX= 7 JMAX= 13/2
0.53152E 00 0.76759E 00 0.76980E 00 0.40590E 00 0.40431E 00 0.48298E 00 0.56140E 00 0.48159E-01 0.60107E-01 0.76257E-02
0.10339E-01 0.35734E-03 0.38858E-03 0.11583E-04

E= 0.20000E 01(MEV) LMAX= 7 JMAX= 13/2
0.53754E 00 0.76645E 00 0.76390E 00 0.43860E 00 0.43087E 00 0.58439E 00 0.67331E 00 0.76146E-01 0.95461E-01 0.15217E-01
0.18266E-01 0.84395E-03 0.90596E-03 0.29607E-04

E= 0.25000E 01(MEV) LMAX= 8 JMAX= 15/2
0.53996E 00 0.75755E 00 0.75341E 00 0.48351E 00 0.45839E 00 0.72789E 00 0.80550E 00 0.14851E 00 0.18327E 00 0.46824E-01
0.46730E-01 0.33805E-02 0.35104E-02 0.13845E-03 0.69550E-04 0.78004E-05

E= 0.30000E 01(MEV) LMAX= 9 JMAX= 17/2
0.53839E 00 0.74857E 00 0.75100E 00 0.50935E 00 0.47068E 00 0.81142E 00 0.84925E 00 0.22797E 00 0.27360E 00 0.11071E 00
0.87414E-01 0.96693E-02 0.97685E-02 0.46710E-03 0.25542E-03 0.35727E-04 0.23475E-04 0.58788E-06

E= 0.40000E 01(MEV) LMAX= 10 JMAX= 19/2
0.54193E 00 0.74424E 00 0.75415E 00 0.53575E 00 0.49607E 00 0.87663E 00 0.83815E 00 0.36076E 00 0.42029E 00 0.32927E 00
0.13046E 00 0.41079E-01 0.43500E-01 0.28700E-02 0.19449E-02 0.33647E-03 0.19250E-03 0.78601E-05 0.15950E-04 0.46055E-06

E= 0.50000E 01(MEV) LMAX= 11 JMAX= 21/2
0.55587E 00 0.75238E 00 0.76103E 00 0.55521E 00 0.53065E 00 0.87339E 00 0.80769E 00 0.45141E 00 0.52759E 00 0.53323E 00
0.27220E 00 0.10604E 00 0.13058E 00 0.10732E-01 0.90003E-02 0.15505E-02 0.89234E-03 0.57227E-04 0.12359E-03 0.40289E-05
0.35473E-05 0.13902E-06

E= 0.60000E 01(MEV) LMAX= 12 JMAX= 23/2
0.57465E 00 0.76335E 00 0.76800E 00 0.57664E 00 0.56350E 00 0.85485E 00 0.78598E 00 0.52179E 00 0.60973E 00 0.63159E 00
0.36201E 00 0.20842E 00 0.28928E 00 0.29070E-01 0.29382E-01 0.49573E-02 0.29352E-02 0.28474E-03 0.59389E-03 0.20997E-04
0.20492E-04 0.11670E-05 0.13967E-05 0.71335E-07

E= 0.70000E 01(MEV) LMAX= 12 JMAX= 23/2
0.59494E 00 0.77349E 00 0.77399E 00 0.59970E 00 0.59115E 00 0.83970E 00 0.77258E 00 0.58572E 00 0.67326E 00 0.67118E 00
0.44202E 00 0.34865E 00 0.48847E 00 0.63767E-01 0.73443E-01 0.13373E-01 0.77674E-02 0.10877E-02 0.19686E-02 0.81155E-04
0.88537E-04 0.58380E-05 0.67738E-05 0.41142E-06

E= 0.80000E 01(MEV) LMAX= 13 JMAX= 25/2
0.61533E 00 0.78198E 00 0.77386E 00 0.62247E 00 0.61645E 00 0.82936E 00 0.76391E 00 0.64267E 00 0.72238E 00 0.69214E 00
0.59697E 00 0.51413E 00 0.65776E 00 0.12131E 00 0.14987E 00 0.32020E-01 0.17773E-01 0.33936E-02 0.50354E-02 0.26362E-03
0.31381E-03 0.23043E-04 0.25373E-04 0.18217E-05 0.18474E-05 0.13581E-06

APPENDIX 2A

RESULTS OF COUPLED CHANNEL CALCULATIONS FOR ^{242}Pu : :

NEUTRON CROSS SECTIONS AND ANGULAR DISTRIBUTIONS.

"Conventions are the same than those explained in Appendix 1A"

COUPLED CHANNEL CALCULATIONS FOR PLUTONIUM 242 (CH,LAGRANGE,77)

NEUTRON TOTAL CROSS SECTIONS

E	S(E)	E	S(E)	E	S(E)
1.0000D 03	2.4727D 01	5.0000D 03	1.7450D 01	1.0000D 04	1.5771D 01
2.0000D 04	1.4591D 01	3.0000D 04	1.4048D 01	4.0000D 04	1.3698D 01
6.0000D 04	1.3075D 01	8.0000D 04	1.2719D 01	1.0000D 05	1.2419D 01
2.0000D 05	1.1341D 01	3.0000D 05	1.0400D 01	4.0000D 05	9.6093D 00
5.0000D 05	8.9585D 00	6.0000D 05	8.4360D 00	7.0000D 05	8.0213D 00
8.0000D 05	7.7028D 00	1.0000D 06	7.3057D 00	1.2500D 06	7.1300D 00
1.5000D 06	7.1605D 00	1.7500D 06	7.2819D 00	2.0000D 06	7.4329D 00
2.5000D 06	7.7165D 00	3.0000D 06	7.9025D 00	4.0000D 06	7.9331D 00
5.0000D 06	7.6078D 00	6.0000D 06	7.1214D 00	7.0000D 06	6.6524D 00
8.0000D 06	6.2699D 00	1.0000D 07	5.8862D 00	1.2000D 07	5.7019D 00
1.4000D 07	5.7922D 00	1.6000D 07	6.0479D 00	1.8000D 07	6.3040D 00
2.0000D 07	6.4596D 00	0.0	0.0	0.0	0.0

COUPLED CHANNEL CALCULATIONS FOR PLUTONIUM 242 (CH,LAGRANGE,77)

NEUTRON COMPOUND NUCLEUS FORMATION CROSS SECTIONS

E	S(E)	E	S(E)	E	S(E)
1.0000D 03	1.3603D 01	5.0000D 03	6.5303D 00	1.0000D 04	5.0326D 00
2.0000D 04	4.1459D 00	3.0000D 04	3.8540D 00	4.0000D 04	3.7313D 00
6.0000D 04	3.6227D 00	8.0000D 04	3.6189D 00	1.0000D 05	3.6356D 00
2.0000D 05	3.8073D 00	3.0000D 05	3.7777D 00	4.0000D 05	3.6926D 00
5.0000D 05	3.6607D 00	6.0000D 05	3.5227D 00	7.0000D 05	3.4600D 00
8.0000D 05	3.4167D 00	1.0000D 06	3.3880D 00	1.2500D 06	3.4193D 00
1.5000D 06	3.4618D 00	1.7500D 06	3.4709D 00	2.0000D 06	3.4419D 00
2.5000D 06	3.3230D 00	3.0000D 06	3.1930D 00	4.0000D 06	3.0053D 00
5.0000D 06	2.8939D 00	6.0000D 06	2.8427D 00	7.0000D 06	2.8458D 00
8.0000D 06	2.8653D 00	1.0000D 07	2.9095D 00	1.2000D 07	2.7841D 00
1.4000D 07	2.7078D 00	1.6000D 07	2.6736D 00	1.8000D 07	2.6448D 00
2.0000D 07	2.6084D 00	0.0	0.0	0.0	0.0

COUPLED CHANNEL CALCULATIONS FOR PLUTONIUM 242 (CH,LAGRANGE,77)

NEUTRON SHAPE ELASTIC SCATTERING CROSS SECTIONS

E	S(E)	E	S(E)	E	S(E)
1.0000D 03	1.1124D 01	5.0000D 03	1.0920D 01	1.0000D 04	1.0739D 01
2.0000D 04	1.0445D 01	3.0000D 04	1.0194D 01	4.0000D 04	9.9672D 00
6.0000D 04	9.4507D 00	8.0000D 04	9.0944D 00	1.0000D 05	8.7714D 00
2.0000D 05	7.4942D 00	3.0000D 05	6.5554D 00	4.0000D 05	5.8228D 00
5.0000D 05	5.2350D 00	6.0000D 05	4.7583D 00	7.0000D 05	4.3709D 00
8.0000D 05	4.0576D 00	1.0000D 06	3.6097D 00	1.2500D 06	3.3089D 00
1.5000D 06	3.2195D 00	1.7500D 06	3.2752D 00	2.0000D 06	3.4187D 00
2.5000D 06	3.7971D 00	3.0000D 06	4.1272D 00	4.0000D 06	4.4102D 00
5.0000D 06	4.2618D 00	6.0000D 06	3.8702D 00	7.0000D 06	3.4251D 00
8.0000D 06	3.0466D 00	1.0000D 07	2.6574D 00	1.2000D 07	2.6170D 00
1.4000D 07	2.8052D 00	1.6000D 07	3.1096D 00	1.8000D 07	3.4052D 00
2.0000D 07	3.6075D 00	0.0	0.0	0.0	0.0

COUPLED CHANNEL CALCULATIONS FOR PLUTONIUM 242 (CH,LAGRANGE,77)

NEUTRON DIRECT INELASTIC FIRST EXCITED LEVEL

E	S(E)	E	S(E)	E	S(E)
6.0000D 04	1.8885D-03	8.0000D 04	6.1450D-03	1.0000D 05	1.1636D-02
2.0000D 05	3.9141D-02	3.0000D 05	6.5700D-02	4.0000D 05	8.9202D-02
5.0000D 05	1.1197D-01	6.0000D 05	1.3562D-01	7.0000D 05	1.6046D-01
8.0000D 05	1.8710D-01	1.0000D 06	2.4233D-01	1.2500D 06	3.0937D-01
1.5000D 06	3.6684D-01	1.7500D 06	4.1080D-01	2.0000D 06	4.4036D-01
2.5000D 06	4.6174D-01	3.0000D 06	4.5061D-01	4.0000D 06	3.9714D-01
5.0000D 06	3.4513D-01	6.0000D 06	3.1248D-01	7.0000D 06	2.9566D-01
8.0000D 06	2.8340D-01	1.0000D 07	2.6446D-01	1.2000D 07	2.5202D-01
1.4000D 07	2.3678D-01	1.6000D 07	2.2766D-01	1.8000D 07	2.2063D-01
2.0000D 07	2.1322D-01	0.0	0.0	0.0	0.0

COUPLED CHANNEL CALCULATIONS FOR PLUTONIUM 242 (CH,LAGRANGE,77)

NEUTRON DIRECT INELASTIC SECOND EXCITED LEVEL

E	S(E)	E	S(E)	E	S(E)
2.0000D 05	7.2176D-05	3.0000D 05	1.3539D-03	4.0000D 05	4.7576D-03
5.0000D 05	1.0767D-02	6.0000D 05	1.9295D-02	7.0000D 05	2.9740D-02
8.0000D 05	4.1404D-02	1.0000D 06	6.5654D-02	1.2500D 06	9.2477D-02
1.5000D 06	1.1238D-01	1.7500D 06	1.2510D-01	2.0000D 06	1.3184D-01
2.5000D 06	1.3462D-01	3.0000D 06	1.3171D-01	4.0000D 06	1.2045D-01
5.0000D 06	1.0699D-01	6.0000D 06	9.6081D-02	7.0000D 06	8.5848D-02
8.0000D 06	7.4631D-02	1.0000D 07	5.4906D-02	1.2000D 07	4.8856D-02
1.4000D 07	4.2392D-02	1.6000D 07	3.7066D-02	1.8000D 07	3.3425D-02
2.0000D 07	3.0383D-02	0.0	0.0	0.0	0.0

COUPLED CHANNEL CALCULATIONS FOR PLUTONIUM 242

LEGENDRE COEFFICIENTS FOR SHAPE ELASTIC
THE LEGENDRE COEFFICIENTS ARE IN THE ORDER 1.2..

```
ELAB= 1.0000E 03  LMAX=    3
                   9.9481D-03  1.1040D-05 -6.2850D-06  0.0

ELAB= 5.0000E 03  LMAX=    3
                   5.3408D-02  3.0913D-04  4.7347D-06  0.0

ELAB= 1.0000E 04  LMAX=    3
                   1.1159D-01  1.2476D-03  8.1273D-06  0.0

ELAB= 2.0000E 04  LMAX=    3
                   2.3239D-01  4.8689D-03  3.5348D-05  0.0

ELAB= 3.0000E 04  LMAX=    3
                   3.5527D-01  1.0709D-02  1.2108D-04  0.0

ELAB= 4.0000E 04  LMAX=    3
                   4.7716D-01  1.8526D-02  2.8769D-04  0.0

ELAB= 6.0000E 04  LMAX=    3
                   6.8002D-01  3.7527D-02  8.7576D-04  0.0

ELAB= 8.0000E 04  LMAX=    3
                   8.9087D-01  6.3064D-02  1.9729D-03  0.0

ELAB= 1.0000E 05  LMAX=    3
                   1.0850D 00  9.3062D-02  3.6799D-03  0.0

ELAB= 2.0000E 05  LMAX=    3
                   1.8406D 00  2.8600D-01  2.3589D-02  0.0

ELAB= 3.0000E 05  LMAX=    5
                   2.2414D 00  4.7546D-01  6.7652D-02  7.0337D-03

ELAB= 4.0000E 05  LMAX=    5
                   2.4108D 00  6.3679D-01  1.3089D-01  1.8510D-02

ELAB= 5.0000E 05  LMAX=    5
                   2.4482D 00  7.6109D-01  2.1002D-01  3.7723D-02

ELAB= 6.0000E 05  LMAX=    6
                   2.4123D 00  8.5368D-01  3.0049D-01  6.5948D-02

ELAB= 7.0000E 05  LMAX=    6
                   2.3399D 00  9.2342D-01  3.9747D-01  1.0368D-01

ELAB= 8.0000E 05  LMAX=    6
                   2.2539D 00  9.7954D-01  4.9714D-01  1.5109D-01
```

```
(CH,LAGRANGE,77)

..6 AND NEXT LINE 7.8.......... 12

 0.0          0.0

 0.0          0.0

 0.0          0.0

 0.0          0.0

 0.0          0.0

 0.0          0.0

 0.0          0.0

 0.0          0.0

 0.0          0.0

 0.0          0.0

-2.0115D-05   0.0

 3.3357D-05   0.0

 2.3749D-04   0.0

 1.3364D-03   5.6379D-04

 3.6855D-03   1.3359D-03

 8.3327D-03   2.7572D-03
```

COUPLED CHANNEL CALCULATIONS FOR PLUTONIUM 242

LEGENDRE COEFFICIENTS FOR SHAPE ELASTIC
THE LEGENDRE COEFFICIENTS ARE IN THE ORDER 1.2..

```
ELAB= 1.0000E 06  LMAX=    8
                  2.09470 00  1.07910 00  6.91970-01  2.73340-01
                  7.50640-04  7.11130-05  0.0          0.0

ELAB= 1.2500E 06  LMAX=    8
                  1.99090 00  1.22140 00  9.06760-01  4.64880-01
                  2.93120-03  3.35440-04  0.0          0.0

ELAB= 1.5000E 06  LMAX=    9
                  2.02470 00  1.39870 00  1.08520 00  6.74570-01
                  8.20150-03  1.11780-03  9.61650-05  0.0

ELAB= 1.7500E 06  LMAX=    9
                  2.16780 00  1.60050 00  1.24230 00  8.77850-01
                  1.84230-02  2.97160-03  3.21820-04  0.0

ELAB= 2.0000E 06  LMAX=    9
                  2.38310 00  1.81360 00  1.39480 00  1.06220 00
                  3.52650-02  6.64760-03  8.64530-04  0.0

ELAB= 2.5000E 06  LMAX=   11
                  2.87440 00  2.23710 00  1.70970 00  1.36950 00
                  9.17870-02  2.21410-02  3.87810-03  4.98580-04

ELAB= 3.0000E 06  LMAX=   12
                  3.29590 00  2.60840 00  2.01450 00  1.61000 00
                  1.74020-01  5.30610-02  1.18150-02  1.86900-03

ELAB= 4.0000E 06  LMAX=   14
                  8.43500-01  6.93790-01  5.55400-01  4.36950-01
                  8.25940-02  3.56730-02  1.16210-02  2.69240-03
                  1.24350-05  2.83460-06  0.0          0.0

ELAB= 5.0000E 06  LMAX=   15
                  8.59930-01  7.28030-01  6.03240-01  4.77790-01
                  1.20450-01  6.57620-02  2.91010-02  9.23810-03
                  7.66980-05  1.48020-05  2.80130-06  0.0

ELAB= 6.0000E 06  LMAX=   16
                  8.63080-01  7.44280-01  6.33180-01  5.13190-01
                  1.57990-01  9.99720-02  5.64060-02  2.33160-02
                  3.92110-04  7.77970-05  1.19950-05  1.30960-06

ELAB= 7.0000E 06  LMAX=   16
                  8.61920-01  7.48190-01  6.49920-01  5.41770-01
                  2.01250-01  1.38870-01  9.32970-02  4.82370-02
                  1.50890-03  3.61070-04  7.40520-05  1.29440-05
```

```
(CH.LAGRANGE.77)

..6 AND NEXT LINE 7.8.....  12

 2.8716D-02  9.1990D-03
 0.0         0.0

 8.6156D-02  2.7227D-02
 0.0         0.0

 1.8526D-01  6.0290D-02
 0.0         0.0

 3.1792D-01  1.0932D-01
 0.0         0.0

 4.6844D-01  1.7290D-01
 0.0         0.0

 7.6893D-01  3.3036D-01
 5.4576D-05  0.0

 1.0211D 00  4.9850D-01
 2.6646D-04  2.0068D-05

 3.0696D-01  1.7535D-01
 5.2786D-04  8.3990D-05
 0.0         0.0

 3.5133D-01  2.1960D-01
 2.3443D-03  4.8334D-04
 0.0         0.0

 3.8902D-01  2.6256D-01
 7.5758D-03  1.9838D-03
 0.0         0.0

 4.2429D-01  3.0717D-01
 1.9559D-02  6.2242D-03
 0.0         0.0
```

COUPLED CHANNEL CALCULATIONS FOR PLUTONIUM 242

LEGENDRE COEFFICIENTS FOR SHAPE ELASTIC
THE LEGENDRE COEFFICIENTS ARE IN THE ORDER 1.2...

ELAB= 8.0000E 06 LMAX= 17

8.58140-01	7.4269D-01	6.5158D-01	5.5732D-01
2.47920-01	1.8113D-01	1.3613D-01	8.4444D-02
4.52020-03	1.2611D-03	2.9201D-04	6.3308D-05

ELAB= 1.0000E 07 LMAX= 18

8.55920-01	7.2487D-01	6.3001D-01	5.5391D-01
3.30040-01	2.6653D-01	2.2367D-01	1.7447D-01
2.37920-02	8.1898D-03	2.4706D-03	6.5724D-04

ELAB= 1.2000E 07 LMAX= 20

8.63980-01	7.2068D-01	6.1090D-01	5.3438D-01
3.64050-01	3.1688D-01	2.7601D-01	2.3573D-01
5.41090-02	2.3431D-02	8.9639D-03	2.9673D-03
5.8663D-05	1.3291D-05	0.0	0.0

ELAB= 1.4000E 07 LMAX= 21

8.85460-01	7.5291D-01	6.4153D-01	5.5634D-01
3.90800-01	3.4969D-01	3.0883D-01	2.6856D-01
8.69410-02	4.5397D-02	2.1113D-02	8.4930D-03
2.70550-04	7.6948D-05	1.6861D-05	0.0

ELAB= 1.6000E 07 LMAX= 22

9.09730-01	7.9941D-01	6.9711D-01	6.0809D-01
4.22650-01	3.7756D-01	3.3381D-01	2.8922D-01
1.16290-01	6.9332D-02	3.7626D-02	1.8002D-02
9.41020-04	3.0260D-04	8.6123D-05	2.0466D-05

ELAB= 1.8000E 07 LMAX= 23

9.27250-01	8.3716D-01	7.4893D-01	6.6411D-01
4.59990-01	4.0727D-01	3.5774D-01	3.0812D-01
1.39750-01	9.0509D-02	5.4995D-02	3.0511D-02
2.50790-03	9.2238D-04	2.8226D-04	8.7987D-05

ELAB= 2.0000E 07 LMAX= 24

9.37060-01	8.6065D-01	7.8590D-01	7.1002D-01
4.98260-01	4.3346D-01	3.8235D-01	3.2772D-01
1.58760-01	1.0325D-01	7.0852D-02	4.4075D-02
5.47190-03	2.2429D-03	7.6817D-04	2.6454D-04

(CH,LAGRANGE.77)

..6 AND NEXT LINE 7.8.....12

4.5312D-01	3.4771D-01
4.1092D-02	1.5435D-02
1.2154D-05	0.0

4.8016D-01	4.0353D-01
1.1019D-01	5.7890D-02
1.5021D-04	3.0496D-05

4.7201D-01	4.1653D-01
1.7482D-01	1.0784D-01
8.4941D-04	2.3781D-04
0.0	0.0

4.8950D-01	4.3711D-01
2.1474D-01	1.4809D-01
2.9972D-03	9.9400D-04
0.0	0.0

5.3376D-01	4.7377D-01
2.3870D-01	1.7743D-01
7.4448D-03	2.9518D-03
0.0	0.0

5.8669D-01	5.1899D-01
2.5644D-01	1.9909D-01
1.5214D-02	6.7264D-03
2.1766D-05	0.0

6.3471D-01	5.6343D-01
2.7276D-01	2.1640D-01
2.5104D-02	1.2624D-02
9.2283D-05	2.6741D-05

COUPLED CHANNEL CALCULATIONS FOR PLUTONIUM 242 (CH,LAGRANGE,77)

LEGENDRE COEFFICIENTS FOR DIRECT INELASTIC (1 LEVEL)
THE LEGENDRE COEFFICIENTS ARE IN THE ORDER 1.2...6 AND NEXT LINE 7.8..... 12

```
ELAB= 6.0000E 04  LMAX=    3
                   5.9851D-04  8.2933D-05 -3.1883D-06  0.0          0.0          0.0

ELAB= 8.0000E 04  LMAX=    3
                   1.8275D-03  2.7184D-04 -2.0475D-05  0.0          0.0          0.0

ELAB= 1.0000E 05  LMAX=    3
                   3.3777D-03  4.9014D-04 -5.7845D-05  0.0          0.0          0.0

ELAB= 2.0000E 05  LMAX=    3
                   1.1706D-02  1.0783D-03 -5.8272D-04  0.0          0.0          0.0

ELAB= 3.0000E 05  LMAX=    5
                   1.7268D-02 -9.7721D-04 -1.9376D-03  3.2212D-04 -6.9637D-06  0.0

ELAB= 4.0000E 05  LMAX=    5
                   2.0498D-02 -3.3701D-03 -3.7051D-03  8.4613D-04 -2.0811D-05  0.0

ELAB= 5.0000E 05  LMAX=    5
                   2.1897D-02 -5.9901D-03 -5.7770D-03  1.6236D-03 -4.2473D-05  0.0

ELAB= 6.0000E 05  LMAX=    6
                   2.2227D-02 -8.5458D-03 -7.7703D-03  2.1390D-03 -8.1553D-05  9.1775D-05

ELAB= 7.0000E 05  LMAX=    6
                   2.1950D-02 -1.0632D-02 -1.0065D-02  2.7211D-03 -1.0290D-04  2.0312D-04

ELAB= 8.0000E 05  LMAX=    6
                   2.1373D-02 -1.2241D-02 -1.2322D-02  3.0081D-03 -1.0502D-04  3.9203D-04

ELAB= 1.0000E 06  LMAX=    8
                   1.9933D-02 -1.4098D-02 -1.6240D-02  2.1483D-03  1.2604D-04  1.0644D-03
                  -3.7270D-05  1.4246D-05  0.0          0.0          0.0          0.0

ELAB= 1.2500E 06  LMAX=    8
                   1.8593D-02 -1.4690D-02 -1.9631D-02 -2.0523D-03  8.5514D-04  2.5216D-03
                  -1.2435D-04  6.5342D-05  0.0          0.0          0.0          0.0

ELAB= 1.5000E 06  LMAX=    9
                   1.8624D-02 -1.4288D-02 -2.1646D-02 -8.5530D-03  2.4211D-03  4.2472D-03
                  -2.1264D-04  2.4470D-04 -1.3340D-05  0.0          0.0          0.0

ELAB= 1.7500E 06  LMAX=    9
                   2.1216D-02 -1.3060D-02 -2.2791D-02 -1.3988D-02  5.2838D-03  5.6799D-03
                  -2.9334D-04  5.6759D-04 -4.0210D-05  0.0          0.0          0.0

ELAB= 2.0000E 06  LMAX=    9
                   2.7343D-02 -1.0012D-02 -2.2322D-02 -1.5743D-02  9.2504D-03  6.0894D-03
                  -1.9370D-04  1.1158D-03 -9.3314D-05  0.0          0.0          0.0
```

COUPLED CHANNEL CALCULATIONS FOR PLUTONIUM 242 (CH.LAGRANGE.77)

LEGENDRE COEFFICIENTS FOR DIRECT INELASTIC (1 LEVEL)
THE LEGENDRE COEFFICIENTS ARE IN THE ORDER 1.2...6 AND NEXT LINE 7.8..... 12

```
ELAB= 2.5000E 06  LMAX=   11
                   4.8146D-02  2.5223D-03 -1.3448D-02 -8.3761D-03  1.7818D-02  3.4707D-03
                   8.9740D-04  2.4550D-03 -2.5338D-04  1.8893D-04 -3.4344D-06  0.0

ELAB= 3.0000E 06  LMAX=   12
                   6.8993D-02  1.6768D-02  1.6069D-03  2.8171D-03  2.3969D-02 -9.7060D-04
                   2.1200D-03  3.3209D-03 -3.2943D-04  6.0293D-04 -1.7298D-05  1.2662D-05

ELAB= 4.0000E 06  LMAX=   14
                   2.1676D-01  7.6681D-02  4.4602D-02  3.1839D-02  6.3448D-02 -1.0362D-02
                  -2.0922D-03 -1.5782D-04  1.1149D-03  6.1093D-03 -4.0565D-04  3.5174D-04
                   1.4324D-05  3.6722D-06  0.0          0.0          0.0          0.0

ELAB= 5.0000E 06  LMAX=   15
                   2.4759D-01  8.4016D-02  3.4106D-02  3.2440D-02  4.3788D-02 -6.1854D-03
                  -2.2604D-02 -2.4543D-02  7.7110D-03  1.2330D-02 -1.8877D-03  2.0114D-03
                   6.3770D-05  4.3438D-05  6.1397D-06  0.0          0.0          0.0

ELAB= 6.0000E 06  LMAX=   16
                   2.7422D-01  7.8249D-02  8.2737D-03  1.4335D-02  1.1033D-02 -1.2773D-02
                  -3.5000D-02 -3.9723D-02  1.3695D-02  9.0102D-03 -3.4854D-03  6.3891D-03
                   8.0702D-05  2.2686D-04  4.5700D-05  5.2606D-06  0.0          0.0

ELAB= 7.0000E 06  LMAX=   16
                   2.9671D-01  7.7630D-02 -1.3211D-03  1.1272D-03 -5.6315D-03 -1.7497D-02
                  -2.9398D-02 -3.9931D-02  6.4836D-03 -5.7644D-03 -1.6275D-03  1.2631D-02
                  -2.0560D-04  7.8376D-04  2.0196D-04  3.1974D-05  0.0          0.0

ELAB= 8.0000E 06  LMAX=   17
                   3.1475D-01  8.4147D-02 -8.1042D-04 -5.7892D-03 -1.3518D-02 -2.2570D-02
                  -2.7146D-02 -4.3566D-02 -8.6904D-03 -1.7794D-02  4.6079D-03  1.7316D-02
                  -9.2119D-04  2.1059D-03  6.2480D-04  1.2831D-04  3.9643D-05  0.0

ELAB= 1.0000E 07  LMAX=   18
                   3.9598D-01  1.1707D-01  2.1502D-02 -1.2529D-02 -2.8402D-02 -4.1058D-02
                  -4.2266D-02 -5.5361D-02 -3.1520D-02 -1.6091D-02  4.4628D-03  1.1338D-02
                   1.1173D-02  8.3574D-03  1.5767D-03  2.0579D-03  3.0399D-04  1.2647D-04

ELAB= 1.2000E 07  LMAX=   20
                   4.5596D-01  1.7257D-01  5.6287D-02  1.1287D-02 -1.1475D-02 -2.8934D-02
                  -3.3452D-02 -3.8921D-02 -2.4118D-02 -8.1874D-03  1.0786D-02  9.7204D-03
                   1.1815D-02  6.4928D-03  4.8302D-03  6.5314D-03  8.2098D-04  7.4808D-04
                   1.5192D-04  4.5667D-05  0.0          0.0          0.0          0.0

ELAB= 1.4000E 07  LMAX=   21
                   4.9431D-01  2.1461D-01  8.5573D-02  4.2431D-02  1.4345D-02 -2.0433D-03
                  -8.9578D-03 -1.4489D-02 -5.7452D-03  2.1520D-03  1.5728D-02  6.9883D-03
                   1.8246D-03 -1.0652D-03  1.0060D-02  1.0557D-02  1.5580D-03  2.8590D-03
                   5.6561D-04  2.8838D-04  6.9199D-05  0.0          0.0          0.0
```

COUPLED CHANNEL CALCULATIONS FOR PLUTONIUM 242 (CH,LAGRANGE,77)

LEGENDRE COEFFICIENTS FOR DIRECT INELASTIC (1 LEVEL)
THE LEGENDRE COEFFICIENTS ARE IN THE ORDER 1.2...6 AND NEXT LINE 7.8..... 12

ELAB= 1.6000E 07 LMAX= 22

5.19750-01	2.50660-01	1.14940-01	6.82540-02	3.50530-02	2.21230-02
1.10030-02	5.19450-03	7.36950-03	9.01330-03	1.59880-02	8.41450-03
2.90920-03	-1.90460-03	1.12890-02	8.26820-03	3.61420-03	7.60740-03
1.59170-03	1.14540-03	3.66820-04	1.13070-04	0.0	0.0

ELAB= 1.8000E 07 LMAX= 23

5.3646D-01	2.8065D-01	1.4102D-01	8.9800D-02	5.6193D-02	4.5161D-02
3.3601D-02	2.8204D-02	2.5902D-02	2.3737D-02	2.5482D-02	1.6099D-02
1.1040D-02	-2.6758D-03	1.8198D-03	-9.6537D-04	7.6826D-03	1.3572D-02
3.4229D-03	3.5666D-03	1.1524D-03	4.9820D-04	1.3693D-04	0.0

ELAB= 2.0000E 07 LMAX= 24

5.4837D-01	2.9968D-01	1.5537D-01	9.9151D-02	6.4983D-02	5.4621D-02
4.6355D-02	4.1453D-02	3.8604D-02	3.2349D-02	3.0517D-02	1.6095D-02
8.8133D-03	-8.2858D-03	-9.7467D-03	-1.0829D-02	8.7009D-03	1.4684D-02
5.7578D-03	8.0353D-03	2.7359D-03	1.3231D-03	4.7898D-04	1.4667D-04

COUPLED CHANNEL CALCULATIONS FOR PLUTONIUM 242 (CH,LAGRANGE,77)

LEGENDRE COEFFICIENTS FOR DIRECT INELASTIC (2 LEVEL)
THE LEGENDRE COEFFICIENTS ARE IN THE ORDER 1.2...6 AND NEXT LINE 7.8.....12

```
ELAB= 2.0000E 05  LMAX=    3
                   1.8292D-05  9.5706D-06  9.0603D-07  0.0         0.0         0.0

ELAB= 3.0000E 05  LMAX=    5
                   5.3895D-04  3.0136D-04  2.2368D-05  1.7781D-06 -2.4021D-07  0.0

ELAB= 4.0000E 05  LMAX=    5
                   2.0825D-03  1.0721D-03  6.6325D-05 -1.0659D-07 -1.2363D-06  0.0

ELAB= 5.0000E 05  LMAX=    5
                   4.8795D-03  2.3109D-03  9.9981D-05 -1.7583D-05 -3.1806D-06  0.0

ELAB= 6.0000E 05  LMAX=    6
                   8.8476D-03  3.7121D-03 -3.9706D-05 -7.9295D-05 -3.7648D-06  2.0061D-06

ELAB= 7.0000E 05  LMAX=    6
                   1.3458D-02  5.0487D-03 -3.1375D-04 -1.6726D-04  1.3067D-06  4.5146D-06

ELAB= 8.0000E 05  LMAX=    6
                   1.8277D-02  5.9677D-03 -8.0155D-04 -2.8215D-04  1.7758D-05  8.3365D-06

ELAB= 1.0000E 06  LMAX=    8
                   2.6954D-02  5.5966D-03 -2.4744D-03 -5.3543D-04  1.5489D-04  1.5452D-05
                  -6.7501D-06  6.7705D-07  0.0         0.0         0.0         0.0

ELAB= 1.2500E 06  LMAX=    8
                   3.3388D-02  1.2037D-03 -4.7707D-03 -3.6177D-04  4.3578D-04  1.9224D-06
                  -2.0341D-05  3.1069D-06  0.0         0.0         0.0         0.0

ELAB= 1.5000E 06  LMAX=    9
                   3.5373D-02 -4.6055D-03 -5.6585D-03  7.3617D-04  7.6275D-04 -8.5453D-05
                  -3.0783D-05  9.6954D-06 -1.8732D-06  0.0         0.0         0.0

ELAB= 1.7500E 06  LMAX=    9
                   3.5168D-02 -8.3870D-03 -4.6548D-03  2.3599D-03  9.1132D-04 -2.3929D-04
                  -3.0539D-05  1.8969D-05 -4.8786D-06  0.0         0.0         0.0

ELAB= 2.0000E 06  LMAX=    9
                   3.4406D-02 -9.3438D-03 -2.3463D-03  3.8696D-03  7.7699D-04 -4.2056D-04
                  -3.3331D-06  2.6793D-05 -1.0577D-05  0.0         0.0         0.0

ELAB= 2.5000E 06  LMAX=   11
                   3.2942D-02 -7.1544D-03  2.1504D-03  4.8162D-03 -1.1451D-04 -5.4928D-04
                   1.4542D-04 -1.7613D-05 -3.2570D-05  1.1899D-05 -5.9466D-07  0.0

ELAB= 3.0000E 06  LMAX=   12
                   3.1780D-02 -4.5651D-03  4.1363D-03  3.2796D-03 -9.0575D-04 -1.0190D-04
                   2.7891D-04 -1.9013D-04 -5.4052D-05  3.5671D-05 -3.4492D-06  1.1222D-06
```

COUPLED CHANNEL CALCULATIONS FOR PLUTONIUM 242 (CH,LAGRANGE,77)

LEGENDRE COEFFICIENTS FOR DIRECT INELASTIC (2 LEVEL)
THE LEGENDRE COEFFICIENTS ARE IN THE ORDER 1.2.....6 AND NEXT LINE 7.8..... 12

```
ELAB= 4.0000E 06  LMAX=   14
                   2.4360D-01 -7.1750D-03  3.6880D-02 -5.4232D-03 -2.3097D-03  7.8259D-03
                  -4.0267D-03 -4.9589D-03  6.5726D-04  6.3496D-04 -2.2707D-04  1.4313D-04
                   1.3132D-06  1.7946D-06  0.0          0.0          0.0          0.0

ELAB= 5.0000E 06  LMAX=   15
                   2.3872D-01  1.1363D-02  3.1729D-02 -2.9421D-02  2.5044D-03 -3.5107D-03
                  -1.8106D-02  3.1086D-03  4.6792D-03 -1.5174D-03 -6.6091D-04  5.8365D-04
                  -2.8614D-05  1.3951D-05  1.5359D-06  0.0          0.0          0.0

ELAB= 6.0000E 06  LMAX=   16
                   2.2980D-01  3.3159D-02  3.1057D-02 -3.7821D-02  6.2392D-03 -1.4007D-02
                  -1.9848D-02  2.3977D-02  5.9491D-03 -7.8851D-03 -2.2272D-04  1.5032D-03
                  -2.2754D-04  5.8340D-05  6.2742D-06  1.5547D-06  0.0          0.0

ELAB= 7.0000E 06  LMAX=   16
                   2.3057D-01  5.9988D-02  3.8404D-02 -2.5626D-02  1.8924D-02 -7.9733D-03
                  -1.0054D-02  3.0355D-02 -2.7993D-03 -1.1941D-02  3.0350D-03  2.1144D-03
                  -8.1713D-04  1.5263D-04  1.3206D-05  5.1078D-06  0.0          0.0

ELAB= 8.0000E 06  LMAX=   17
                   2.4836D-01  8.6384D-02  4.0998D-02 -1.5183D-02  2.4978D-02 -6.7442D-03
                  -6.7145D-03  1.5926D-02 -1.3953D-02 -6.1408D-03  8.4071D-03  1.1117D-03
                  -1.7837D-03  3.3338D-04  1.0816D-05  1.5714D-05  1.0307D-05  0.0

ELAB= 1.0000E 07  LMAX=   18
                   3.5605D-01  1.2790D-01  4.2995D-02 -3.4543D-03  7.6846D-03 -1.4924D-02
                  -8.0591D-03 -2.6287D-03  5.7356D-04  1.4814D-02  2.6627D-03 -2.3532D-03
                   1.8281D-03 -1.5757D-03 -5.5448D-04  6.9212D-04  2.4622D-05  6.1591D-05

ELAB= 1.2000E 07  LMAX=   20
                   3.9849D-01  1.5505D-01  6.3603D-02  1.2347D-02  1.2744D-02 -1.1139D-02
                   3.5357D-03 -2.1317D-03  7.1725D-03  2.0487D-02  4.7397D-03  7.4537D-03
                  -1.6017D-04 -8.4307D-03  3.2660D-04  1.4223D-03 -2.4171D-04  3.3763D-04
                   2.7581D-05  1.8426D-05  0.0          0.0          0.0          0.0

ELAB= 1.4000E 07  LMAX=   21
                   4.1082D-01  1.8770D-01  8.9352D-02  2.4373D-02  2.1668D-02 -6.7376D-03
                   1.0299D-02 -9.9496D-04  8.0148D-03  1.6104D-02  3.8158D-03  9.3623D-03
                  -8.5604D-03 -7.4157D-03  5.0596D-03 -1.1816D-03 -1.1524D-03  1.0534D-03
                  -7.9542D-05  1.0702D-04  2.3669D-05  0.0          0.0          0.0

ELAB= 1.6000E 07  LMAX=   22
                   4.1904D-01  2.3252D-01  1.1441D-01  4.1753D-02  3.2844D-02 -3.2656D-03
                   1.3318D-02 -4.0916D-03  6.6856D-03  7.2714D-03  1.1995D-03  7.0116D-03
                  -9.4586D-03  6.9678D-03  6.1433D-03 -9.5309D-03 -7.8122D-04  1.0098D-03
                  -6.9685D-04  4.0518D-04  1.1678D-04  5.7738D-05  0.0          0.0
```

COUPLED CHANNEL CALCULATIONS FOR PLUTONIUM 242 (CH,LAGRANGE,77)

LEGENDRE COEFFICIENTS FOR DIRECT INELASTIC (2 LEVEL)
THE LEGENDRE COEFFICIENTS ARE IN THE ORDER 1.2.....6 AND NEXT LINE 7.8..... 12

ELAB= 1.8000E 07 LMAX= 23

4.4078D-01	2.7565D-01	1.3272D-01	6.2406D-02	4.3657D-02	5.4158D-03
1.8592D-02	-1.5647D-03	1.1652D-02	7.9349D-03	6.8964D-03	1.5953D-02
-4.5426D-03	1.1833D-02	-4.0524D-03	-1.4605D-02	2.9703D-03	5.7412D-05
-2.0830D-03	1.2732D-03	3.1022D-04	2.6664D-04	7.5452D-05	0.0

ELAB= 2.0000E 07 LMAX= 24

4.5656D-01	3.0345D-01	1.4937D-01	8.1757D-02	4.9642D-02	9.8477D-03
1.7539D-02	-3.7941D-03	8.2827D-03	2.6979D-03	1.5320D-03	1.1517D-02
-8.8646D-03	6.4373D-03	-8.9434D-03	-6.0431D-03	6.5350D-03	-7.2937D-03
-3.7461D-03	2.5406D-03	4.3121D-04	6.1939D-04	2.3402D-04	9.1358D-05

APPENDIX 2B

RESULTS OF COUPLED CHANNEL CALCULATIONS FOR ^{242}Pu :

NEUTRON TRANSMISSION COEFFICIENTS FOR THE GROUND STATE.

NEUTRON TRANSMISSION COEFFICIENTS FOR PLUTONIUM 242

THE COEFFICIENTS ARE IN THE ORDER (L,J): (0,1/2),(1,1/2),(1,3/2),(2,3/2),(2,5/2),(3,5/2),(3,7/2), ...

E= 0.10000E-02(MEV) LMAX= 3 JMAX= 5/2
0.20096E-01 0.11993E-03 0.16286E-03 0.40499E-07 0.26471E-07 0.54955E-11

E= 0.50000E-02(MEV) LMAX= 3 JMAX= 5/2
0.44350E-01 0.13317E-02 0.18072E-02 0.22491E-05 0.14726E-05 0.15351E-08

E= 0.10000E-01(MEV) LMAX= 3 JMAX= 5/2
0.62090E-01 0.37329E-02 0.50610E-02 0.12617E-04 0.82796E-05 0.17354E-07

E= 0.20000E-01(MEV) LMAX= 3 JMAX= 5/2
0.86530E-01 0.10363E-01 0.14019E-01 0.70192E-04 0.46264E-04 0.19605E-06

E= 0.30000E-01(MEV) LMAX= 3 JMAX= 5/2
0.10476E 00 0.18672E-01 0.25198E-01 0.19020E-03 0.12592E-03 0.80917E-06

E= 0.40000E-01(MEV) LMAX= 3 JMAX= 5/2
0.11978E 00 0.28186E-01 0.37934E-01 0.38386E-03 0.25528E-03 0.22116E-05

E= 0.60000E-01(MEV) LMAX= 3 JMAX= 5/2
0.14511E 00 0.48361E-01 0.65305E-01 0.10017E-02 0.70468E-03 0.88080E-05

E= 0.80000E-01(MEV) LMAX= 3 JMAX= 5/2
0.16533E 00 0.71417E-01 0.96072E-01 0.19884E-02 0.14125E-02 0.24035E-04

E= 0.10000E 00(MEV) LMAX= 3 JMAX= 5/2
0.18269E 00 0.95731E-01 0.12823E 00 0.33577E-02 0.24088E-02 0.52347E-04

E= 0.20000E 00(MEV) LMAX= 3 JMAX= 5/2
0.24853E 00 0.22865E 00 0.30085E 00 0.16125E-01 0.12249E-01 0.65781E-03

E= 0.30000E 00(MEV) LMAX= 4 JMAX= 7/2
0.29497E 00 0.34718E 00 0.44247E 00 0.37315E-01 0.29777E-01 0.26968E-02 0.30272E-02 0.32883E-04

E= 0.40000E 00(MEV) LMAX= 4 JMAX= 7/2
0.33228E 00 0.44784E 00 0.55289E 00 0.64411E-01 0.53787E-01 0.72180E-02 0.80551E-02 0.11469E-03

E= 0.50000E 00(MEV) LMAX= 4 JMAX= 7/2
0.36376E 00 0.53063E 00 0.63569E 00 0.94959E-01 0.82547E-01 0.15317E-01 0.17040E-01 0.29973E-03

E= 0.60000E 00(MEV) LMAX= 5 JMAX= 9/2
0.39094E 00 0.59721E 00 0.69581E 00 0.12703E 00 0.11429E 00 0.28066E-01 0.31143E-01 0.65258E-03 0.69871E-03 0.26273E-04

E= 0.70000E 00(MEV) LMAX= 5 JMAX= 9/2
0.41459E 00 0.64957E 00 0.73769E 00 0.15923E 00 0.14746E 00 0.46409E-01 0.51376E-01 0.12525E-02 0.13752E-02 0.60914E-04

E= 0.80000E 00(MEV) LMAX= 5 JMAX= 9/2
0.43522E 00 0.68970E 00 0.76513E 00 0.19065E 00 0.18080E 00 0.71031E-01 0.78473E-01 0.21918E-02 0.24618E-02 0.12594E-03

NEUTRON TRANSMISSION COEFFICIENTS FOR PLUTONIUM 242

THE COEFFICIENTS ARE IN THE ORDER (L,J): (0,1/2),(1,1/2),(1,3/2),(2,3/2),(2,5/2),(3,5/2),(3,7/2), ...

```
            E= 0.10000E 01(MEV)      LMAX=    6     JMAX=   11/2
0.46877E 00 0.74104E 00 0.78945E 00 0.24908E 00 0.24444E 00 0.13965E 00 0.15408E 00 0.55075E-02 0.64324E-02 0.42102E-03
0.70910E-03 0.94296E-05

            E= 0.12500E 01(MEV)      LMAX=    6     JMAX=   11/2
0.49894E 00 0.76911E 00 0.78838E 00 0.31200E 00 0.31336E 00 0.25372E 00 0.28205E 00 0.13518E-01 0.16395E-01 0.13884E-02
0.20996E-02 0.40750E-04

            E= 0.15000E 01(MEV)      LMAX=    7     JMAX=   13/2
0.51898E 00 0.77628E 00 0.77606E 00 0.36382E 00 0.36789E 00 0.37718E 00 0.42527E 00 0.27419E-01 0.34124E-01 0.36253E-02
0.49443E-02 0.13467E-03 0.14888E-03 0.40997E-05

            E= 0.17500E 01(MEV)      LMAX=    7     JMAX=   13/2
0.53134E 00 0.77424E 00 0.76388E 00 0.40582E 00 0.40811E 00 0.48940E 00 0.55748E 00 0.48442E-01 0.61125E-01 0.80522E-02
0.99921E-02 0.36822E-03 0.40294E-03 0.12122E-04

            E= 0.20000E 01(MEV)      LMAX=    7     JMAX=   13/2
0.53804E 00 0.76828E 00 0.75479E 00 0.43938E 00 0.43566E 00 0.58254E 00 0.66316E 00 0.76841E-01 0.97184E-01 0.15891E-01
0.18052E-01 0.87129E-03 0.94100E-03 0.30755E-04

            E= 0.25000E 01(MEV)      LMAX=    8     JMAX=   15/2
0.54130E 00 0.75322E 00 0.74489E 00 0.48596E 00 0.46388E 00 0.71551E 00 0.78855E 00 0.15076E 00 0.18676E 00 0.47923E-01
0.45287E-01 0.34989E-02 0.36503E-02 0.14092E-03 0.71454E-04 0.81061E-05

            E= 0.30000E 01(MEV)      LMAX=    9     JMAX=   17/2
0.53999E 00 0.74100E 00 0.74175E 00 0.51284E 00 0.47537E 00 0.79666E 00 0.83178E 00 0.23234E 00 0.27884E 00 0.11133E 00
0.85436E-01 0.10015E-01 0.10159E-01 0.46603E-03 0.26283E-03 0.37153E-04 0.23413E-04 0.60700E-06

            E= 0.40000E 01(MEV)      LMAX=   10     JMAX=   19/2
0.54360E 00 0.73478E 00 0.74472E 00 0.53964E 00 0.50083E 00 0.86494E 00 0.82404E 00 0.36830E 00 0.42821E 00 0.32336E 00
0.17797E 00 0.42491E-01 0.45409E-01 0.28161E-02 0.20048E-02 0.34832E-03 0.19075E-03 0.81093E-05 0.16941E-04 0.46626E-06

            E= 0.50000E 01(MEV)      LMAX=   11     JMAX=   21/2
0.55781E 00 0.74309E 00 0.75210E 00 0.55898E 00 0.53534E 00 0.86345E 00 0.79635E 00 0.46005E 00 0.53695E 00 0.52282E 00
0.27035E 00 0.10948E 00 0.13654E 00 0.10569E-01 0.92584E-02 0.16003E-02 0.88850E-03 0.59013E-04 0.13058E-03 0.40648E-05
0.36137E-05 0.17211E-06

            E= 0.60000E 01(MEV)      LMAX=   12     JMAX=   23/2
0.57694E 00 0.75462E 00 0.75970E 00 0.58050E 00 0.56755E 00 0.84589E 00 0.77651E 00 0.53114E 00 0.61858E 00 0.62204E 00
0.35990E 00 0.21507E 00 0.30009E 00 0.28833E-01 0.30064E-01 0.51391E-02 0.29436E-02 0.29385E-03 0.61832E-03 0.21237E-04
0.21000E-04 0.11894E-05 0.14253E-05 0.72524E-07

            E= 0.70000E 01(MEV)      LMAX=   12     JMAX=   23/2
0.59747E 00 0.76534E 00 0.76630E 00 0.60347E 00 0.59430E 00 0.83164E 00 0.76454E 00 0.59526E 00 0.67970E 00 0.66316E 00
0.44041E 00 0.35935E 00 0.49847E 00 0.63792E-01 0.74915E-01 0.13941E-01 0.78339E-02 0.11240E-02 0.20188E-02 0.82887E-04
0.91495E-04 0.59540E-05 0.68925E-05 0.41817E-06

            E= 0.80000E 01(MEV)      LMAX=   13     JMAX=   25/2
0.61793E 00 0.77440E 00 0.77176E 00 0.62583E 00 0.61884E 00 0.82220E 00 0.75705E 00 0.65108E 00 0.72625E 00 0.68553E 00
0.50557E 00 0.52653E 00 0.65989E 00 0.12228E 00 0.15319E 00 0.33386E-01 0.17999E-01 0.35120E-02 0.51289E-02 0.27153E-03
0.32625E-03 0.23516E-04 0.25813E-04 0.18511E-05 0.18381E-05 0.13849E-06
```