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NUCLEAR DATA EVALUATION FOR PA-233

by

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work performed in the framework of the IAEA-NDS Coordinated Research Programme on the Intercomparison of Evaluations of Actinide Neutron Nuclear Data

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CONTENTS

pag.

ABSTRACT 1

INTRODUCTION 2

1. THE DECAY DATA 4

2. THE RESONANCE PARAMETERS 5

2.1. Resolved resonances 5

2.2. Unresolved resonances 6

3. CROSS SECTION EVALUATION IN THE FAST ENERGY RANGE 9

3.1. The total and elastic cross sections 9

3.2. The inelastic scattering cross section 12

3.3. The fission cross section 13

3.4. The radiative capture cross section 15

3.5. The (n, 2n) and (n, 3n) cross sections 16

4. THE AVERAGE NUMBER OF NEUTRONS PER FISSION 17

5. ELASTIC AND INELASTIC ANGULAR DISTRIBUTIONS

OF SECONDARY NEUTRONS 19

6. THE ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS 20

CONCLUSIVE REMARKS 26

7. FIGURE CONTENTS 28

8. TABLES 30

9. FIGURES 40

10. APPENDIX 65

THE NEUTRON DATA EVALUATION FOR ^{233}Pa

Abstract

In this report the evaluation of main neutron nuclear data for ^{233}Pa, namely neutron cross sections (total, elastic, inelastic, radiative capture, fission, (n,2n), (n,3n)), as well as the elastic and inelastic angular distributions, and energy distributions of secondary neutrons from inelastic scattering, (n,2n), (n,3n) and fission reactions, is described.

In the same time, radioactive decay data and average number of neutrons per fission are given.

For the resolved and unresolved resonance energy range, the Breit-Wigner single level parameters have been estimated.

The data cover the energy range between 10^{-5}eV and 20 MeV.

The final set of evaluated data is given in ENDF/B format and have been checked against physical consistency and format correctness.

Many of the data have been calculated using theoretical models.

Introduction

This evaluation has been performed in the framework of IAEA - NDS Coordinated Research Programme on the Intercomparison of Evaluations of Actinide Neutron Nuclear Data.

The CINDA index and EXFOR-data base for the documentation on experimental data and theoretical considerations, regarding ^{233}Pa isotope, have been used.

For thermal and resonance (resolved and unresolved) range, the total, elastic and radiative capture cross sections, between 10^{-5}eV and 10 keV, have been estimated using evaluated Breit-Wigner single level parameters.

In the fast energy range, total, elastic and scattering data have been estimated using spherical optical and statistical models up to 2 MeV, and coupled channel theory (nonadiabatic approximation) + compound nucleus contributions between 2 and 5 MeV. Above 5 MeV, the adiabatic approximation has been used. The optical potential parameters used, have been those recently proposed by Madland and Young (1978).

The (n,2n), (n,3n) and fission (above 4 MeV) cross sections have been evaluated using evaporation model. The fission (under 4 MeV), radiative capture, and inelastic cross sections were evaluated by statistical model (Hauser-Feshbach).

The average number of neutrons emited per fission, was estimated using Howerton's systematics.

In the lack of experimental data, the energy distribution of secondary neutrons from (n,n') reaction, have been obtained in the framework of evaporation model, using the density level parameter evaluated by back-shifted Fermi gas model.

The energy distributions for (n,2n) and (n,3n) were estimated by Le Couteur's neutron cascade theory in the framework of statistical model.

The energy distribution for fission neutron was evaluated using the Terrel's formula.

1. The decay data

The decay data for ^{233}Pa (Fig.1) have been extracted from ENDSF (Evaluated Nuclear Structure and Decay File - 1978) and [1]. Using these data the mean energy per decay $\langle E_\beta \rangle$ and $\langle E_\gamma \rangle$ have been calculated under considerations mentioned in [2] and [3].

For mean energy evaluation $\langle E_\beta \rangle$, has been used the approximation [3]:

$$\langle E_\beta \rangle = \frac{10 + 8x + 2x^2}{10 + 5x + x^2} \times \frac{E_\beta}{4} \qquad (1)$$

where $x = E_\beta / M_0 c^2$. The mean values which characterize the radioactive decay of ^{233}Pa are,

$$T_{1/2} = (27.0 \pm 0.1)d ,$$

$$\langle E_\beta \rangle = 66.4 \text{ keV} ,$$

$$\langle E_\gamma \rangle = 9.395 \text{ MeV}.$$

In the Fig.1 the radioactive decay scheme is showed, and the Table 1 presents the characteristic radiations of radioactive decay of ^{233}Pa.

References

1 . Nucl.Data Sheets 24,289 (1978).

2 . T.R.England and R.E.Schenter, LA-6116-MS (ENDF-223). Los Alamos Scientific Laboratory, Oct.1975.

3 . C.W.Reich, R.G.Helmer and M.H.Putnam, ANCR-1157 (ENDF-120) Aerojet Nuclear Company, Aug.1974.

2. The resonance parameters

2.1. Resolved resonances

The total cross section in the resolved resonance range is given in the references [1] and [2].

In the same time, the experimental resonance parameters are given by Simpson [3] and Harris [4], covering the energy range up to 17 eV and up to 36.2, respectively.

We had also available the data reported in BNL-325 [5], as well as the evaluated parameters adopted in JENDL-1 library [6].

Harris' data have been obtained by area analysis of measurements and he reported also the adjusted parameters, to give a better agreement to radiative capture resonance integral (846 ± 29 bn).

We have adopted these adjusted values of Harris except the parameter Γ_n for the negative resonance, which has been taken a little smaller (0.0006123) to give a better agreement in the thermal range for the total cross section.

The elastic, capture and total cross sections have been computed from resolved resonance parameters using ETRES code [7].

The adopted Breit-Wigner single level parameters are presented in Table II comparatively with the parameters from JENDL-1 and BNL-325, and the computed total cross sections is shown in Fig.2.

References

1 . W.H.Burgus, F.B.Simpson, EANDC(US)-44 (1963).

2 . F.B.Simpson, Conf.on Neutr.C.S.Technology, Washington, 22 - 24 Mar.1966, p.67.

3 . F.B.Simpson et al., Nucl.Sci.Eng., 28,133-138(1967).

4 . A.R.Harris, WAPD-TM-814 (1969).

5 . BNL-325, vol.1 (1973).

6 . Japanese library JNDL-1.

7 . D.Gheorghe, ETRES programme, private communication.

2.2. Unresolved resonances

The unresolved resonance region analysis was performed between 38.5 eV and 10^4eV.

Based on resolved resonance parameters, some attempts have been made to estimate the averaged parameters for the unresolved resonances, by usual techniques.

To determine $\bar{D}(0)$ and $\langle g\Gamma_n^o\rangle$, the cumulative number of s-wave resonances and $\sum g\Gamma_n^o$ versus energy were plotted (Figs.3 and 4).

The small number of resolved resonances makes impossible to use the statistical methods.

We considered that $\bar{D}(0)$ = 0.69 eV, often found in different attempts, seems to be good.

Because $\langle g\Gamma_n^o\rangle$ seems to be underestimated due to the small number of resolved resonances, we have considered that it can be $\langle g\Gamma_n^o\rangle = 0.65\cdot 10^{-4}$eV, saving the value of $\langle g\Gamma_n^1\rangle$.

The averaged values adopted in this work are obtained starting from: $\bar{D}(0) = 0{,}69$ eV [1], $\langle g\,\Gamma_n^0 \rangle = 0.65 \cdot 10^{-4}$ eV, and $\langle g\,\Gamma_n^1 \rangle = 2.07 \cdot 10^{-4}$ eV [2].

The following formulae have been used [3]:

$$\langle \Gamma_n^{\ell}(J) \rangle = \frac{\mu_{\ell,J} \cdot w_{I,\ell}}{g} \langle g\,\Gamma_n^{\ell} \rangle \qquad (1)$$

and:

$$\bar{D}(\ell, J) = \frac{(2\ell + 1) \cdot w_{I,\ell}}{g} \bar{D}(\ell) \qquad (2)$$

where $\mu_{\ell,J}$ is the number of degree of freedom for the neutron width distribution and

$$w_{I,\ell} \begin{cases} = \dfrac{\ell + 1}{2\ell + 1} & \text{for } \ell \leq I \\ = \dfrac{I + 1}{2I + 1} & \text{for } \ell > I \end{cases} \qquad (3)$$

g is the statistical weight factor:

$$g = \frac{2J + 1}{2(2I + 1)}, \quad \text{for neutrons.} \qquad (4)$$

The results are presented in the Table III.

With these averaged parameters, the total, elastic and capture cross sections have been computed using the programme AVERAGE-3 [4].

The computed total cross section is plotted in the fig.5 together with the experimental data from EXFOR library.

References

1 . S.F.Mughabghab et al., BNL-325, vol.1, 1973.

2 . M.K.Drake et al., GA-7462, 1967.

3 . M.Gyulassy et al., Nucl.Sci.Eng. 53,482, 1974.

4 . M.R.Bath, BNL-52092, 1971.

3. Cross section evaluation in the fast energy range

3.1. The total and elastic cross sections

Above 10 keV there are no experimental data for these cross sections. Consequently they have been estimated using theoretical models.

Up to 2 MeV the optical and statistical models have been used, and the calculations themselves performed with ELIESE programme [1].

Above 2 MeV, the coupled channel theory was used, taking into account the nuclear deformation, with the code JUPITOR [2]. The deformation parameters used are $\beta_2 = 0.19$ and $\beta_4 = 0.071$.

The compound elastic cross section has been estimated by Hauser-Feshbach-Wolfenstein theory up to 5 MeV; at higher energies this section becomes less than 1%.

The coupled channel calculation have been performed with nonadiabatic approximation up to 5 MeV, and with adiabatic approximation at higher energies.

The selection of optical potential parameters is based on Madland and Young's systematics [3] for actinide region. Their method to adjuste the spherical optical parameters to be used in coupled channel calculations for this mass region, has been also adopted for ^{233}Pa.

The Madland-Young parametrization gives:

$$V_R = V_R^o - V_R^1 E_L - V_R^2 E_L^2 \qquad (1)$$

$$W_D = W_D^o - W_D^1 E_L + W_D^2 E_L^2 - W_D^3 \eta \qquad (2)$$

$$a_I = a_I^o + a_I^1 E_L \qquad (3)$$

where V_R is the real part of the spherical optical potential, W_D is the nuclear surface part of the imaginary potential and a_I is the associated diffuseness parameter; η is the isospin parameter $\eta = (N - Z)/A$.

The coefficients from eq.(1)-(3), and the other optical parameters used are given in table IV.

The parameters for the internal part of the imaginary potential are zeros.

To convert the "spherical" parameters (s) to "deformed" parameters for their use for coupled channel calculations (cc), Madland gives the following formulae:

$$(W_D a_I)_{cc}/(W_D a_I)_s = \alpha \cong 0.7 \qquad (4)$$

respectively:

$$\frac{(W_D)_{cc}}{(W_D)_s} \cdot \frac{(a_I)_{cc}}{(a_I)_s} = 0.75 \times 0.94 = 0.705 \qquad (5)$$

and:

$$\frac{(V_R)_{cc}}{(V_R)_s} = \beta = 1.025 \qquad (6)$$

Our calculations have been made with adjusted Madland-Young parameters obtained from (4)-(6), for each energy.

The reaction cross section was corrected to take into account the competitive processes, radiative capture and fission,

by a correction factor:

$$\alpha_{J\pi}(E) = \frac{\sigma_{\gamma}(E) + \sigma_{f}(E)}{\sigma_{R}(E)} \qquad (7)$$

where the spin dependence was neglected, $\sigma_{\gamma}(E)$ and $\sigma_{f}(E)$ are taken from the present work and the reaction cross section $\sigma_{R}(E)$ is previously estimated taking into account only shape elastic scattering:

$$\sigma_{R}(E) = \sigma_{T} - \sigma_{SE} \qquad (8)$$

σ_{SE} is shape elastic cross section, and σ_{T} is total cross section.

The results for elastic and total cross sections, together with the data from JENDL library, are presented in the Table V, and Figs.6, 7, 8.

References

1 . S.Igarasi, JAERI-1224-1972.

2 . T.Tamura, ORNL-4152 (1967).

3 . D.G.Madland, P.G.Young, Proceeding of the Neutron Physics and Nuclear Data International Conference, Harwell, 1978, p.349.

3.2. The inelastic scattering cross sections

There are no experimental cross sections for inelastic scattering available.

In these circumstances we calculated the inelastic scattering cross sections for first 17 excited levels [1] up to 0.3661 MeV as well as for the continuum region above this energy.

In the Table VI are given the excitation energy, spin and parity and threshold energy for adopted levels.

The calculations have been performed using ELIESE code, taking into account for the level density the parameters described in para.6.

The other parameters and corrections ($\alpha_{J\pi}$) are those mentioned in §3.1.

A comparison of our results with JENDL values for the 17 levels, continuum and total inelastic cross sections, is presented in figs.9a - 9r, 10, 11.

References

1 . C.M.Lederer et al., Table of Isotopes, 1978.

3.3. The fission cross section

The fission cross section, in the lack of experimental data, has been estimated based on Lynn's systematics [1], using the statistical model Hauser-Feshbach up to 3 MeV and the evaporation model above 3 MeV.

The programme MASTER [2], an improved version of the program FISINGA [3], using a double humped potential nuclear model for fission and taking into account the coupling between levels, has been used to calculate the fission cross section up to 3 MeV.

The Back's [6] fission barriers for compound nucleus ^{234}Pa were adopted, because, on the one hand, V_A has a weak dependence against mass number A, and on the other hand, V_B has a weak dependence against the number of neutrons N, but decreases strongly when the number of protons Z increases.

The used values were the followings:

$$V_A = 5.75 \text{ MeV} \qquad V_B = 6.0 \text{ MeV}$$

$$\hbar\omega_A = 0.6 \text{ MeV} \qquad \hbar\omega_B = 0.45 \text{ MeV}$$

With the programme STATMOD [4], based on neutron evaporation model [5], the fission cross section above 3 MeV was calculated.

Gilbert and Cameron [7] and Wapstra [8] parameters have been used. The fission level density, a_f, was considered according to [5] as:

$$a_f = a_n + \frac{c}{U}$$

where a_n is the level density parameter (Fermi gas model) of the deformed nucleus [7],

U is the effective excitation energy [7],

c is a constant properly chosen to joint the two fission cross sections at 3 MeV.

Thus, c $\approx$ 15 MeV, and consequently $a_f/a_n \approx 1.14$ for $U = U_x = 3.5$ MeV is within the normal limits.

It is to be noted that this programme uses only one fission barrier, assuming that reaction channel opens for energies higher than the highest barrier (for Pa isotopes this one is V_B).

For each sequential process, the Back's barriers [6] have been chosen, those of Viola [9] being to high.

The thresholds for the second and third fission chances have been considered 6.2 MeV and 12.717 MeV, respectively.

In the Table VII are given the computed fission cross sections and in the Fig.12 they are plotted together with corresponding values from JENDL.

References

1 . J.E.Lynn, Systematics for neutron reactions of the actinide nuclei, AERE-7468 (1974), Harwell.

2 . N.Dragan, L.Pintiliescu, Program MASTER, private communication.

3 . J.Krebs et al., FISINGA program, DRP/SMPNF-832 (1970), Saclay.

4 . N.Dragan, L.Pintiliescu, Program STATMOD, private communication.

5 . J.Jary, Proc.of the EANDC Topical Discussion on Critique of Nuclear Models and their Validity in the Evaluation of Nuclear Data, JAERI-M-5984 (1975).

6 . B.B.Back, H.C.Britt, O.Hansen, B.Leroux, J.D.Garsett, Phys.Rev.C10 (1974) 1948.

7 . A.Gilbert, A.G.W.Cameron, Can.J.Phys., 43 (1965) 1446.

8 . A.H.Wapstra, N.B.Grave, Nucl.Data Tables, 9, 45 (1971).

9 . V.E.Viola, B.D.Wilkins, Nucl.Phys.,82 (1966) no.1.

3.4. The radiative capture cross section

The radiative capture cross section has been estimated by MASTER programme (see § 3.3) for 0.01 - 3.2 MeV energy range, taking into account one giant resonance with Γ_G = 50 MeV and $E_G = 80 / A^{1/3}$ (MeV), where A is the mass number for compound nucleus ^{234}Pa.

Two level density models (constant temperature and Fermi gas have been used. The temperature T, the joining energy E_{IP} and the Fermi level density parameter 'a' were taken from Lynn's systematics ([1], § 3.3).

Above 3 MeV we adopted the JENDL values, and above 15 MeV, those obtained from consistency.

The data are given in Table VII, and fig.13.

No comparison with experimental data was possible.

3.5. The (n,2n) and (n,3n) cross sections

These cross sections were also computed by the programme STATMOD.

The thresholds for these reactions are 6.517 MeV and 12.079 MeV respectively, with parameters of Gilbert and Cameron ([1], § 3.3).

The computed values are presented in Table VII, and plotted in Fig.14 together with JENDL values.

No comparison with experimental data was possible.

A general view of the fast cross sections (> 10 keV) is shown in Fig.15.

4. The average number of neutrons per fission

The average number of neutrons per fission has been estimated using Howerton's systematics [1], using his semiempirical formula which takes into account the contributions of (n,n'f) and (n,2nf) processes:

$$\bar{\nu}(Z,A,E_n) = \sum_{n=0}^{N} R_n \times \Big\{ n + \bar{\nu}_{th}(A-n,Z) + \bar{\nu}_1(A-n) \cdot \Big[E_n - E_B(A) + E_B(A-n) - n \cdot \bar{E}_T(n) - E_{th}(Z,A-n) \Big] \Big\} \qquad (1)$$

where n = 0, 1, 2,

E_n is incident neutron energy, and:

$$R_o(E_n) = \frac{\sigma_{direct\ fiss.}(E_n)}{\sigma_{fiss.}(E_n)}$$

$$R_1(E_n) = \frac{\sigma_{n,n'f}(E_n)}{\sigma_{fiss.}(E_n)} \qquad (2)$$

$$R_2(E_n) = \frac{\sigma_{n,2nf}(E_n)}{\sigma_{fiss.}(E_n)}$$

$E_B(A)$, $E_B(A-n)$ are the total binding energies of the nuclei with Z protons and A, respectively (A-n) nucleons.

$E_T(n)$ is the mean energy of pre-scission neutrons.

$E_{th}(A-n)$ is the threshold energy of the fission for the nucleus with Z protons and (A-n) nucleons.

$\bar{\nu}_{th}(A,Z)$ and $\bar{\nu}_1(A)$ are defined as follows:

$$\bar{\nu}_{th}(A,Z) = 2.33 + 0.06\left[2 - (-1)^{A+1-Z} - (-1)^{Z}\right] + \\ + 0.15(Z - 92) + 0.02(A-235)$$

$$\bar{\nu}_1(A) = 0.130 + 0.006(A - 235) \qquad (3)$$

and, $E_{th}(A,Z)$ is:

$$E_{th}(A,Z) = 18.6 - 0.36\cdot Z^2/(A + 1) + \\ + 0.2\left[2 - (-1)^{A+1-Z} - (-1)^{Z}\right] - B_n \qquad (4)$$

where B_n is the binding energy of the last neutron in the nucleus (A+1).

The results are presented in Table VIII and are plotted comparatively to JENDL data in fig.16. The differences are between 3.6% and 10%. We have no possibility to compare with experimental data.

References

1 . R.J.Howerton, NDE, 62, p.438, 1977.

5. Elastic and inelastic angular distributions of secondary neutrons

The elastic angular distributions of secondary neutrons have been evaluated by optical and statistical models (see §3.1), from 10 keV up to 20 MeV.

Below 10 keV, the angular distributions are isotropic.

The calculated values have been fitted by Legendre polynomials using the programme SAD [1].

The final evaluated file contains the normalized Legendre coefficients in CM system, at 23 energies, and the corresponding transformation matrix as well.

The elastic angular distributions can be computed by:

$$\frac{d\sigma(E,\theta)}{d\Omega} = \frac{\sigma_{el}(E)}{4\pi} \sum_{\ell=0}^{N} (2\ell + 1)\, C_\ell\, P_\ell\, (\cos\theta) \qquad (1)$$

where $\sigma_{el}(E)$ is the elastic cross section, C_ℓ are the Legendre coefficients and P_ℓ (cos θ) are the Legendre polynomials.

The elastic angular distributions are shown in figs.17a-17v and fig.18, for energies between 0.5 MeV and 20 MeV.

The inelastic angular distributions of secondary neutrons have been assumed to be isotropic.

References

1 . E.M.Pennington et al., Program for analysis of scattering angular distributions, ANL-7306, 1967.

6. The energy distributions of secondary neutrons

The energy distributions of secondary neutrons from (n,n' continuum), (n,2n), (n,3n) and (n,f) reactions, have been obtained, based on level density evaluation, and neutron cascades in the framework of statistical model [1].

For inelastic scattering in continuum region, the energy distribution of secondary neutrons is described by an evaporation spectrum (figs.21, 22):

$$f(E \rightarrow E') \sim E' \exp(-E'/\Theta_1) \qquad (1)$$

where the temperature Θ_1 is derived from level density of ^{233}Pa.

The evaporation spectra corresponding to neutron cascades for the energy distribution of the emitted neutrons from (n,2n) and (n,3n) reactions, are described by Le Couteur [1]:

$$f(E \rightarrow E') \sim (E')^{5/11} \exp(-12 \cdot E'/11 \cdot \Theta_1) \qquad (2)$$

This last representation is an unadequate form for ENDF/B library and in addition the spectrum (2) is not significantly different than the Maxwellian one. Under these considerations, the energy distributions of secondary neutrons from (n,2n) and (n,3n) reactions have been described by a Maxwellian spectrum, with temperature $11 \cdot \Theta_1/12$,(fig.25 - 28):

$$f(E \rightarrow E') \sim (E')^{1/2} \exp(-12 \cdot E'/11 \cdot \Theta_1) \qquad (3)$$

To obtain the nuclear temperature Θ_1, the level density parameters was evaluated first.

The level density parameters for ^{233}Pa are given by Gilbert-Cameron [2] as follows: a = 28.88 MeV^{-1}, E = 3.8 MeV, T = 0.405 MeV, E_o = -0.85 MeV, P = 0.57 MeV.

For lower excitation energies ($E_{ex} < E_x$ = 3.8 MeV), the nuclear temperature θ is 0.405 MeV, and for higher energies ($E_{ex} > E_x$), is given by the expression [2]:

$$\frac{1}{\theta_1} = \frac{1}{t} - \frac{3}{2U} \qquad (4)$$

where t is termodynamic temperature and U is effective excitation energy:

$$U = E_{ex} - P$$
$$U = at^2 \qquad (5)$$

In the fig.19 the nuclear temperature variation, derived from (4) and (5) is shown.

We try also to estimate the level density by a more recent semiempirical model, namely back-shifted Fermi gas. This model fits simultaneously both, the lower and higher levels ($E_{ex} > B_n$) by a single formula.

Because the ^{233}Pa is no present in the parameter systematics of this model [3], the associated parameters for ^{233}Pa have been obtained as the average of the parameters for ^{232}Th and ^{233}U (table IX).

The nuclear temperature has been derived by the relation:

$$\frac{1}{\theta_1} = \frac{1}{t} - \frac{2}{U + t} \qquad (6)$$

where t is the termodynamic temperature:

$$t = (U/a)^{1/2} \tag{7}$$

and:

$$U = E_{ex} - \Delta \tag{8}$$

To test these two models, at lower excitation energies, theirs predictions were compared with experimental data [4], [5] (fig.20). Unfortunately, the levels for ^{233}Pa are well known only up to 0.5 MeV.

Even if at lower excitation energies the agreement of the data based on semiempirical formulae with experimental data, is not generally very good, in this case it is acceptable.

Finally, we prefered the results of back-shifted Fermi gas model.

Its predictions in the range of neutron resonance are compared in fig.20, with compiled data of Lynn [6], Baba [7] and Dilg [3] for ^{233}Th, and ^{233,235,237}U.

The agreement seems to be satisfactory.

The nuclear shell efects as well as the collective effects on level density of deformed nuclei especially, constitutes an intense study at present in the world [8], [9].

To obtain a view on the ^{233}Pa level density calculated in the framework of the most recent microscopic model - a semiempirical formula, taking into account the shell effects, of Kataria, Ramamurthy and Kapoor [10] - the neutron resonance densities of ^{233}Th and ^{233}U, ^{235}U, ^{237}U calculated by this formula have been compared with the back-shifted Fermi gas

predictions. It is to be noted that the calculations have been performed for deformed nuclei with the parameters obtained from spherical nuclei analysis. For this reason the results does not represent a fit of experimental data.

In addition, it was observed that the calculated level spacing is systematicaly higher than experimental values by a factor of 2 [10]. From the fig.20, it can be seen that the microscopic model predictions are systematicaly smaller than the compiled values.

Based on Kataria's observation [10], we compared normalized neutron resonance densities to the experimental data.

The agreement with experimental data, as well as with back-shifted Fermi gas predictions is better, in this case.

Finally, it is to be mentioned the (n,2n), (n,3n) cross sections for ^{232}Th, ^{233}Th, ^{233}Pa and ^{238}U computed by Ihingan [11], using the evaporation model. He used for the level density three formulae of Pearlstein [12], Gilbert-Cameron [2] and Kataria [10].

One result was the agreement to experimental data for ^{232}Th and ^{238}U using Pearlstein's formula, where "a" is higher with $\simeq$ 2.8 than "a" given by Gilbert and Cameron.

However, these results have no influences on our conclusions, because the γ - emission was ignored.

It can to compensate the effect of γ - emission taking a smaller value for "a" parameter. This value was deduced from cross section data for (n,2n) reaction, taking into account

no γ - emission as competitive process and no kinetic momentum dependence in [12]

The nuclear temperature Θ_1 obtained by back-shifted Fermi gas model is compared to that obtained from Gilbert and Cameron model in the fig.19.

The energy distribution of fission neutron (figs.23, 24) was evaluated using the Terrel's formula [13]:

$$\Theta = 0.5 + 0.43\ (1 + \bar{\nu})^{1/2}$$

where $\bar{\nu}$ has the values evaluated in this work.

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1 . K.J.Le Couteur, in "Nuclear Reactions", vol.I, P.M.Endt and M.Demeur (Eds.), North-Holland, Amsterdam, 1959.

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

13 . J.Terrel, in "Proc.Symp.Physics and Chemistry of Fission" Salzburg, 1965, vol.II, p.3, IAEA, Vienna (1965).

Concluding remarks

The evaluated data described in this report are listed in the Appendix in ENDF/B-IV format. It contains:

- general description of evaluation (file 1, MT = 451),
- the number of neutrons per fission (file 1, MT = 452),
- the radioactive decay data (file 1, MT = 457),
- the Breit-Wigner single level resolved and unresolved resonances (file 2, MT = 151),
- the smooth cross sections data (file 3)
    - total c.s. (MT = 1),
    - elastic c.s. (MT = 2),
    - inelastic total c.s. (MT = 4),
    - (n,2n) c.s. (MT = 16),
    - (n,3n) c.s. (MT = 17),
    - fission c.s. (MT = 18),
    - inelastic for excited levels c.s. (MT = 51-67),
    - inelastic continuum c.s. (MT = 91),
    - radiative capture c.s. (MT = 102),
- the angular distributions of neutrons for elastic scattering as Legendre coefficients (file 4, MT = 2), and associated transformation matrix, from CM in LAB system,
- the angular distributions of secondary neutrons (file 4), for all the other reactions,
- the energy distributions of secondary neutrons from (n,2n), (n,3n), fission, and inelastic continuum process.

The data have been checked against the physical consistency and format correctness using the programme CHECKER [1].

Many of our evaluated data have been compared with JENDL-1 evaluation.

As a general conclusion is that the ^{233}Pa neutron interactions are poor represented in the literature by experimental data.

In these circumstances, this evaluation was based mainly on theoretical calculations, but we hope that it will be useful for preliminary calculations of Th - U nuclear energy systems.

As a consequence, the data must be considered an interim evaluation until the availability of more experimental microscopic data.

The increasing importance of Th - U nuclear reactor alternative makes desirable that ^{233}Pa neutron interactions to be much more in the attention of the experimentalists.

References

1 . O.Ozer, Programme CHECK4 (version 1974-1), BNL.

Figure contents

Figure 1 : The radioactive decay scheme of ^{233}Pa.

Figure 2 : The total cross section of ^{233}Pa in the resolved resonance range.

Figure 3 : The cumulative number of s-wave resonances vs. energy.

Figure 4 : The dependence of $\sum g \Gamma_n^o$ vs.energy.

Figure 5 : The total cross section of ^{233}Pa in the unresolved energy range.

Figures 6, 7 : The elastic cross sections of ^{233}Pa in the fast energy range.

Figure 8 : The total cross section of ^{233}Pa in the fast energy range.

Figures 9a-9r : The inelastic cross sections for the first 17 excited levels of ^{233}Pa.

Figure 10 : The inelastic continuum cross section of ^{233}Pa.

Figure 11 : The total inelastic scattering cross section of ^{233}Pa.

Figure 12 : The fission cross section of ^{233}Pa.

Figure 13 : The radiative capture cross section of ^{233}Pa.

Figure 14 : The (n,2n) and (n,3n) cross sections for ^{233}Pa.

Figure 15 : The ^{233}Pa evaluated cross sections in the fast energy range.

Figure 16 : The average number of neutrons per fission of ^{233}Pa

Figures 17a-17v, Figure 18 : The elastic angular distributions of ^{233}Pa

Figure 19 : The nuclear temperature vs.energy for ^{233}Pa.

Figure 20 : The level density vs. energy for ^{233}Pa.

Figures 21, 22 : The energy distributions of secondary neutrons from inelastic continuum scattering.

Figures 23,24 : The energy distributions of fission neutrons.

Figures 25,26 : The energy distributions of neutrons emitted from $^{233}Pa(n,2n)$ reaction.

Figures 27,28 : The energy distributions of neutrons from $^{233}Pa(n,3n)$ reaction.

Table 1

The characteristic radiations of radioactive decay of ^{233}Pa

Type	Energy (keV)	Intensity/100 des.
γ	311.98	36±2
β^-	260.6±2.4	31±4
β^-	232.0±2.4	27±4
β^-	156.7±2.4	22.7±1.7
β^-	174.0±2.4	14.7±2.0
γ	300.12	6.19±0.45
γ	340.50	4.21±0.49

Table II

The resolved resonance parameters for ^{233}Pa

No.	E (eV)			Γ_{tot}(meV)			Γ_n(meV)			Γ_γ(meV)		
	This work	JENDL	BNL	This work	JENDL	BNL	This work	JENDL	BNL	This work	JENDL	BNL
1.	-0.1	-0.6894	-	50.0	50.79	-	0.0006123	0.79	-	50.0	50.0	-
2.	0.43	0.43	-	500.0	50.0	-	0.00079345	0.000852	-	500.0	50.0	-
3.	0.795	0.795	0.795	50.0013	50.0	-	0.0013285	0.00143	0.0014	50.0	50.0	50.0
4.	1.341	1.341	1.341	39.1308	39.14	-	0.130856	0.14	0.139	39.0	39.0	40.0
5.	1.644	1.644	1.644	41.3962	41.43	-	0.396195	0.426	0.38	41.0	41.0	42.0
6.	2.356	2.356	2.356	50.0108	50.01	-	0.0108	0.01167	0.0117	50.0	50.0	50.0
7.	2.83	2.830	2.830	46.1918	46.21	-	0.19177	0.207	0.207	46.0	46.0	46.0
8.	3.386	3.386	3.386	40.3772	40.40	-	0.37722	0.405	0.39	40.0	40.0	50.0
9.	4.288	4.288	4.288	48.1079	48.12	-	0.107886	0.116	0.113	48.0	48.0	48.0
10.	5.152	5.152	5.152	55.4880	55.52	-	0.48801	0.524	0.524	55.0	55.0	55.0
11.	7.181	7.181	7.181	60.1994	60.21	-	0.19937	0.214	0.21	60.0	60.0	60.0
12.	8.26	8.260	8.26	65.0626	65.07	-	0.06205	0.0673	0.0673	65.0	65.0	65.0
13.	8.97	8.970	8.97	70.2061	70.22	-	0.206056	0.222	0.22	70.0	70.0	70.0
14.	9.37	9.37	9.37	71.3958	71.50	-	1.3958	1.5	1.5	70.0	70.0	70.0
15.	10.35	10.35	10.35	50.1316	50.14	-	0.1318	0.142	0.14	50.0	50.0	50.0
16.	10.89	10.89	10.89	65.1917	65.21	-	0.19173	0.206	0.21	65.0	65.0	65.0
17.	11.52	11.52	11.52	50.0984	50.11	-	0.098429	0.106	0.106	50.0	50.0	50.0
18.	11.66	11.66	-	50.01159	50.02	-	0.015878	0.0171	-	50.0	50.0	-
19.	11.93	11.93	-	50.0270	50.03	-	0.025698	0.0276	-	50.0	50.0	-

Table II (cont.)

No.	E (eV)			Γ_{tot}(meV)			Γ_n(meV)			Γ_γ(meV)		
	This work	JENDL	BNL	This work	JENDL	BNL	This work	JENDL	BNL	This work	JENDL	BNL
20.	12.15	12.15	12.15	75.4287	75.46	-	0.42874	0.46	0.46	75.0	75.0	75.0
21.	12.90	12.90	12.90	60.1304	60.14	-	0.130377	0.14	0.14	60.0	60.0	60.0
22.	14.14	14.14	-	50.0280	50.03	-	0.027977	0.03008	-	50.0	50.0	-
23.	14.42	14.42	14.42	70.4937	70.53	-	0.493658	0.532	0.53	70.0	70.0	70.0
24.	14.80	14.80	14.80	50.7156	50.08	-	0.071555	0.0769	0.077	50.0	50.0	50.0
25.	15.96	15.96	15.96	71.1026	71.19	-	1.102619	1.19	1.19	70.0	70.0	70.0
26.	16.35	16.35	-	50.0560	50.06	-	0.056009	0.0604	-	50.0	50.0	-
27.	16.73	16.73	-	50.0573	50.06	-	0.057263	0.0614	-	50.0	50.0	-
28.	17.00	17.0	17.0	50.3418	50.37	-	0.341805	0.367	0.367	50.0	50.0	50.0
29.	18.40	-	-	50.0510	-	-	0.05104	-	-	50.0	-	-
30.	19.0	-	-	50.1452	-	-	0.14515	-	-	50.0	-	-
31.	20.93	-	-	55.9016	-	-	5.9016	-	-	50.0	-	-
32.	21.85	-	-	51.0891	-	-	1.08913	-	-	50.0	-	-
33.	22.87	-	-	52.5920	-	-	2.59198	-	-	50.0	-	-
34.	24.23	-	-	50.6202	-	-	0.62022	-	-	50.0	-	-
35.	26.90	-	-	50.5119	-	-	0.51191	-	-	50.0	-	-
36.	28.18	-	-	50.9608	-	-	0.960835	-	-	50.0	-	-
37.	31.05	-	-	52.2456	-	-	2.245618	-	-	50.0	-	-
38.	32.65	-	-	51.8513	-	-	1.85134	-	-	50.0	-	-
39.	34.40	-	-	50.8035	-	-	0.803526	-	-	50.0	-	-
40.	36.20	-	-	52.2803	--	-	2.280308	-	-	50.0	-	-

Table III

The unresolved resonance parameters for ^{233}Pa

ℓ	J	D(ℓ ,J) (eV)	ν	$\langle\Gamma_n(J)\rangle$ (eV)	$\langle\Gamma_\gamma\rangle$ (eV)
0	1	1.839	1	$1.7332 \cdot 10^{-4}$	$5.5 \cdot 10^{-2}$
	2	1.104	1	$1.04 \cdot 10^{-4}$	$5.5 \cdot 10^{-2}$
1	0	5.52	1	$1.104 \cdot 10^{-3}$	$5.5 \cdot 10^{-2}$
	1	1.839	1	$3.68 \cdot 10^{-4}$	$5.5 \cdot 10^{-2}$
	2	1.104	1	$2.208 \cdot 10^{-4}$	$5.5 \cdot 10^{-2}$
	3	0.787	1	$1.577 \cdot 10^{-4}$	$5.5 \cdot 10^{-2}$

Table IV

The Madland-Young parameters for the spherical optical model potential

V_R^0	50.378	a_R	0.612	r_R	1.264
V_R^1	0.354	-	-	-	-
V_R^2	27.073	-	-	-	-
W_D^0	9.265	a_I^0	0.553	r_I	1.256
W_D^1	0.232	a_I^1	$1.44 \cdot 10^{-2}$	-	-
W_D^2	$3.318 \cdot 10^{-2}$	-	-	-	-
W_D^3	12.666	-	-	-	-
V_{so}	6.2	a_{so}	0.75	r_{so}	1.01

Table V

The elastic and total cross sections for ^{233}Pa

E (MeV)	σ_{se}(b)	σ_{CE}(b)	σ_{el}(b)	σ_{tot}(b)	Model	σ_{el}(b) JENDL	σ_{tot}(b) JENDL
0.01	10.47	3.36	13.836	16.96990	OM + SM	12.0	15.2
0.05	9.63	2.39	12.01	13.84179	OM + SM	11.5	13.35
0.1	8.8	1.52	10.345	12.56330	OM + SM	11.0	12.46
0.5	5.1	0.5	5.6	7.92949	OM + SM	6.6	8.696
0.75	3.89	0.388	4.28	7.27565	OM + SM	5.2	7.479
1.0	3.49	0.343	3.56	6.62185	OM + SM	4.4	6.876
1.5	3.01	0.328	3.34	7.07436	OM + SM	3.675	6.514
2.0	3.59	0.298	3.89	7.52687	OM + SM	3.9	6.901
3.0	4.536	0.215	4.751	8.08047	NACC,SM	4.7	7.57
4.0	4.59	0.164	4.754	8.11925	NACC,SM	4.9	7.627
5.0	4.2098	0.13	4.3398	7.25670	NACC,SM	4.6	7.313
6.0	3.7726	-	3.7726	6.5259	ACC	4.2	6.935
7.0	3.3147	-	3.3147	6.0767	ACC	3.8	6.530
8.0	2.9692	-	2.9692	6.0005	ACC	3.4	6.128
9.0	2.7549	-	2.7549	5.9479	ACC	3.1	5.842
10.0	2.6629	-	2.6629	5.8806	ACC	2.91	5.660
12.0	2.7184	-	2.7184	5.9108	ACC	2.95	5.636
14.0	3.0656	-	3.0656	6.0	ACC	3.0	5.669
16.0	3.3986	-	3.3986	6.1	ACC	-	-
18.0	3.5966	-	3.5966	6.2	ACC	-	-
20.0	3.66345	-	3.66345	6.3	ACC	-	-

OM - optical model
SM - statistical model
ACC - adiabatic approximation (coupled channel)
NACC - nonadiabatic approximation (coupled channel)

Table VI

Inelastic-neutron-excitation energies

Level No.	Excitation energy (MeV)	Threshold energy (MeV)	Spin / Parity
0	0.0	0.0	$3/2^-$
1	0.00668	0.0067	$1/2^-$
2	0.05715	0.0574	$7/2^-$
3	0.0706	0.0709	$5/2^-$
4	0.0865	0.0869	$5/2^+$
5	0.0947	0.0955	$3/2^+$
6	0.1036	0.104	$7/2^+$
7	0.1090	0.1095	$9/2^+$
8	0.1634	0.1641	$11/2^-$
9	0.1691	0.1698	$1/2^+$
10	0.1792	0.1800	$9/2^-$
11	0.2017	0.2026	$3/2^+$
12	0.2123	0.2132	$5/2^+$
13	0.2379	0.2389	$5/2^+$
14	0.2573	0.2584	$5/2^-$
15	0.2796	0.2808	$7/2^+$
16	0.3004	0.3017	$7/2^+$
17	0.3661	0.3677	$9/2^+$

Table VII

The evaluated cross sections in the fast energy range

E (MeV)	σ_{tot}	σ_{el}	σ_{inel}	$\sigma_{n\gamma}$	σ_{nf}	σ_{n2n}	σ_{n3n}
0.01	16.9699	13.836	0.1039	3.03			
0.02			0.152	2.274			
0.03			0.12272	1.977			
0.04			0.175	1.8			
0.05	13.84179	12.01	0.15679	1.675			
0.06			0.19976	1.575			
0.07			0.24714	1.486			
0.08			0.3902	1.371			
0.09			0.53824	1.25			
0.1	12.5633	10.345	1.0893	1.129	0.001		
0.3			1.6661	0.407	0.001		
0.5	7.92949	5.6	1.960	0.275	0.007		
0.7			1.950	0.234	0.052		
0.75			1.950				
0.9			1.95	0.192	0.267		
1.0	6.62185	3.56	1.92	0.168	0.519		
1.2			1.9	0.133	0.859		
1.4			1.85	0.106	1.039		
1.6			1.8	0.086	1.149		
1.8			1.75	0.071	1.23		
2.0	7.52687	3.89	1.7	0.059	1.301		
2.2			1.695	0.047	1.369		
2.4			1.658	0.0435	1.437		
2.6			1.618	0.040	1.504		
2.8			1.583	0.037	1.565		
3.0	8.08047	4.751	1.535	0.0345	1.608		
3.2					1.627		
4.0	8.11925	4.854	1.381	0.026	1.698		
4.5				0.023	1.656		
5.0	7.2567	4.3398	1.362	0.0209	1.516		
5.5				0.0188	1.422		
6.0	6.5259	3.7726	1.368	0.0173	1.368		
6.5				0.016	1.351	0.0	
7.0	6.0767	3.3147	1.244	0.0148	1.449	0.0542	
7.5				0.0137	1.521	0.305	
8.0	6.0005	2.9692	0.8884	0.0129	1.52	0.610	
8.5				0.0123	1.483	0.857	
9.0	5.9479	2.7549	0.7175	0.0115	1.434	1.03	
9.5				0.0108	1.386	1.146	
10.0	5.8806	2.6629	0.6404	0.0103	1.352	1.215	
11.0			0.5981	0.0094	1.34	1.246	
12.0	5.9108	2.7184	0.5678	0.0086	1.286	1.33	0.0
13.0			0.3859	0.008	1.227	1.394	0.131
14.0	6.0	3.0656	0.19	0.0074	1.227	1.263	0.247
15.0			0.103	0.0069	1.384	0.924	0.333
16.0	6.1	3.3986	0.07	0.0064	1.580	0.592	0.453
17.0			0.05	0.0059	1.742	0.353	0.501
18.0	6.2	3.5966	0.035	0.0054	1.868	0.202	0.493
19.0			0.025	0.0049	1.984	0.1	0.48
20.0	6.3	3.66345	0.01215	0.0044	2.1	0.06	0.46

Table VIII

The evaluated average number of neutrons per fission for ^{233}Pa

E (MeV)	$\bar{\nu}$	E (MeV)	$\bar{\nu}$
0	2.3148	11	3.6458
0.5	2.3738	12	3.7600
1	2.4327	13	3.8731
3	2.6687	14	4.0078
6	3.0227	15	4.1902
7	3.1612	18.5	4.7219
9	3.4115	20	4.94

Table IX

The level density parameters for ^{233}Th, ^{233}Pa, and ^{233}U in the framework of back-shifted Fermi gas

Parameter / Isotope	a(MeV^{-1})	I	Δ(MeV)	Ref.
^{233}Th	26.27	I_{rigid}	-0.58	3
^{233}Pa	26.23	I_{rigid}	-0.50	this work
^{233}U	26.19	I_{rigid}	-0.41	3

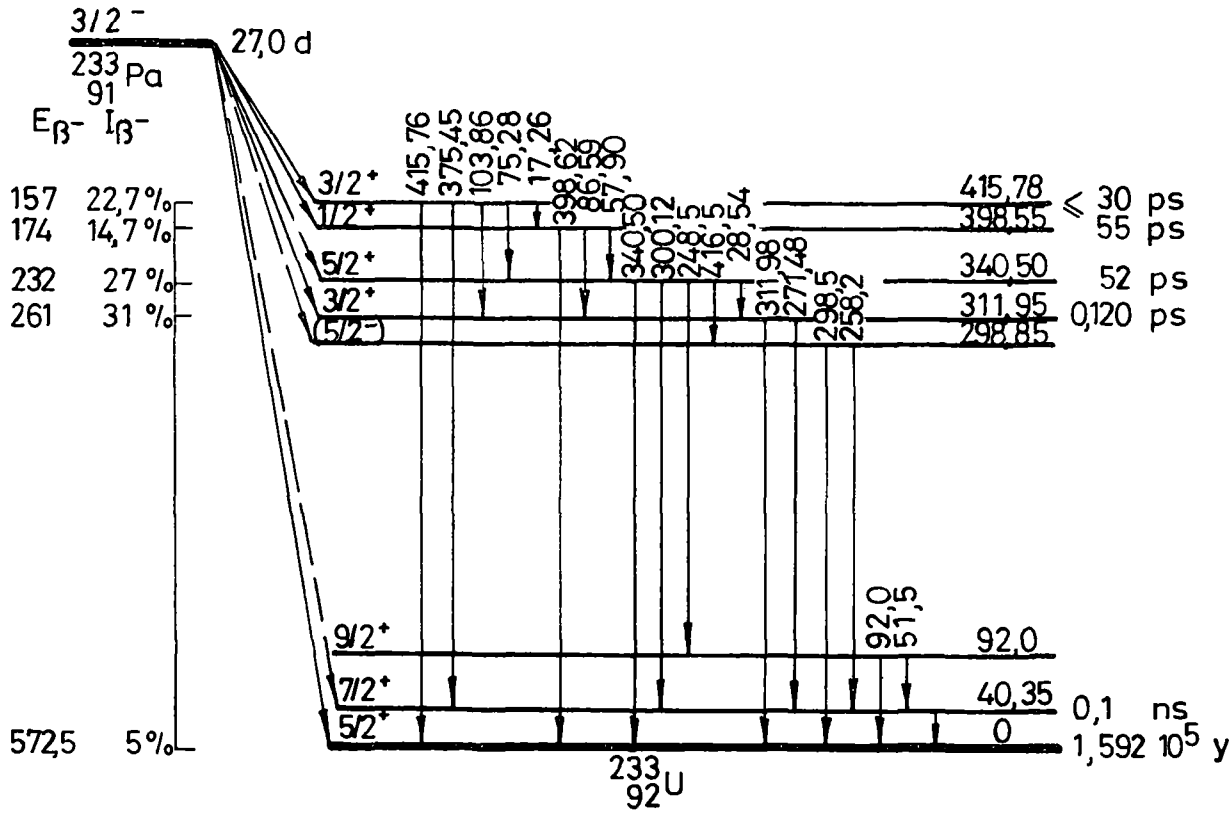


Fig. 1

THE RADIOACTIVE DECAY SCHEME OF ^{233}Pa

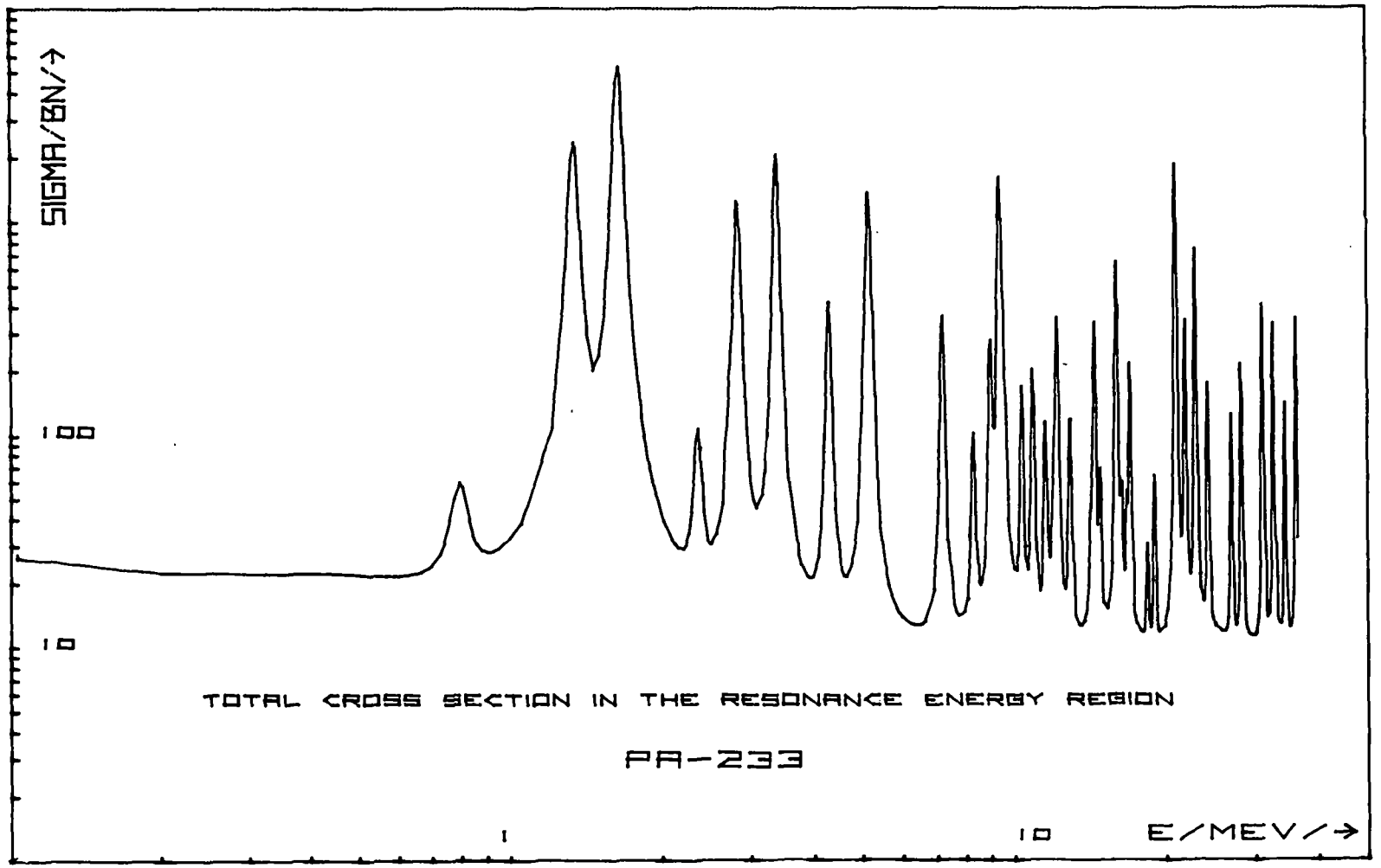

SIGMA/BN/→
100
10
TOTAL CROSS SECTION IN THE RESONANCE ENERGY REGION
PA-233
1
10
E/MEV/→

FIG.2

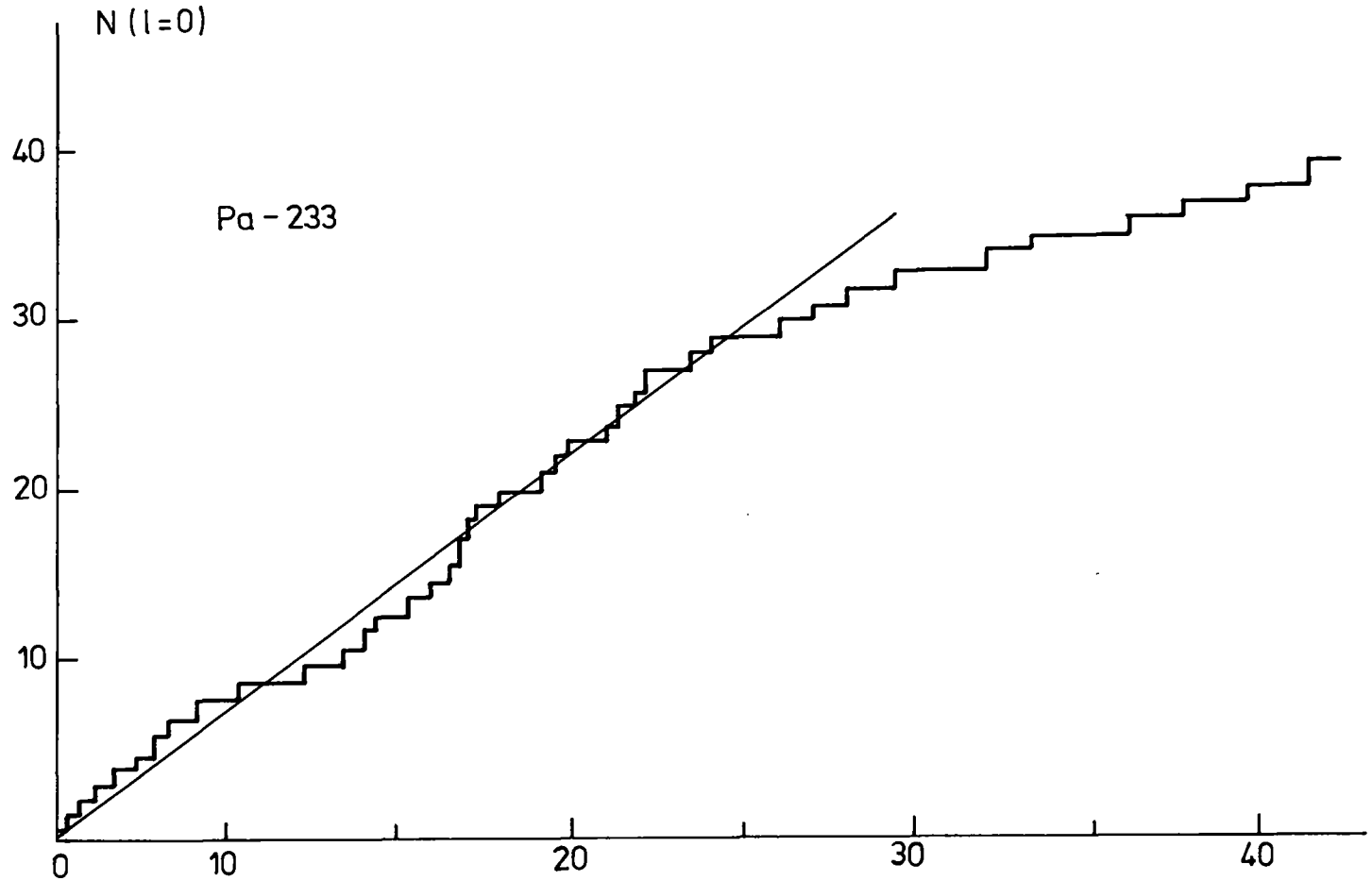


FIG. 3

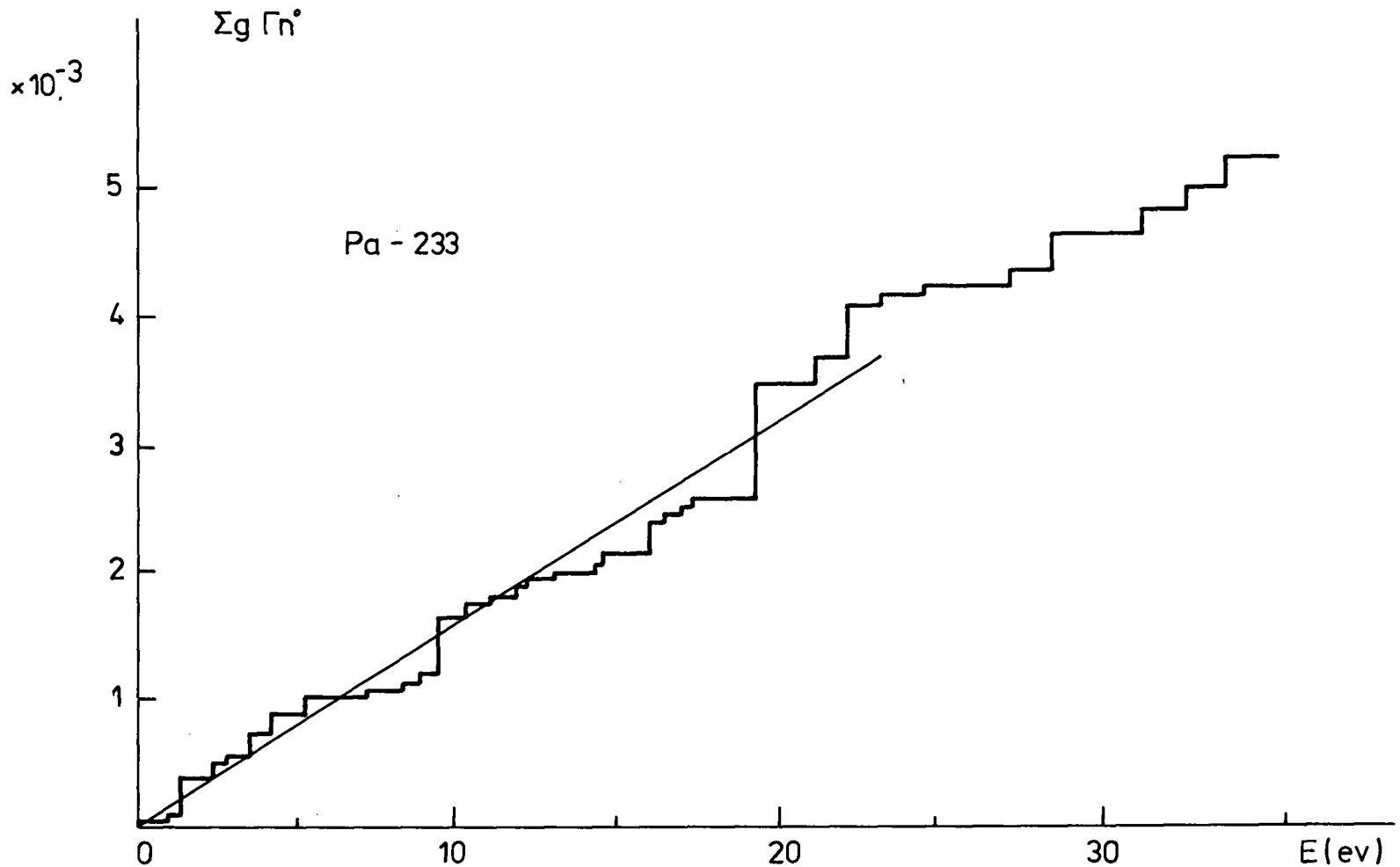


FIG. 4

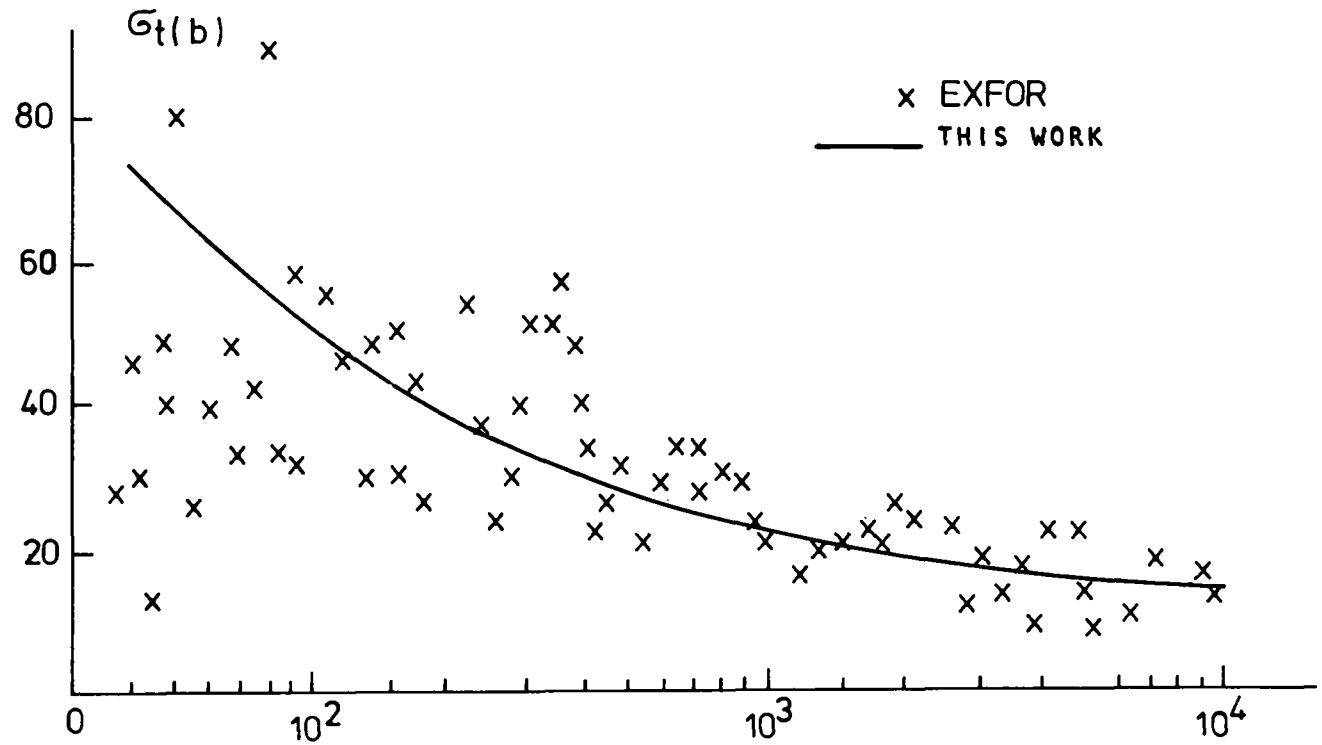


FIG. 5

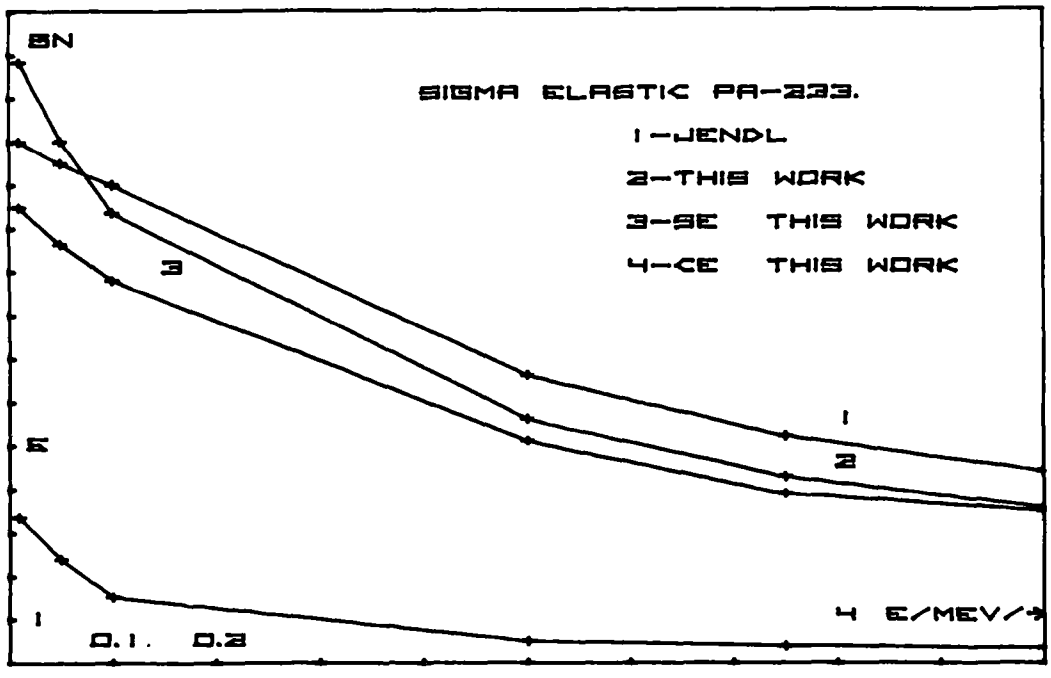

BN
SIGMA ELASTIC PA-233.
1-JENDL
2-THIS WORK
3-SE THIS WORK
4-CE THIS WORK
3
1
2
4
1
0.1
0.2
4 E/MEV/→

FIG.6.

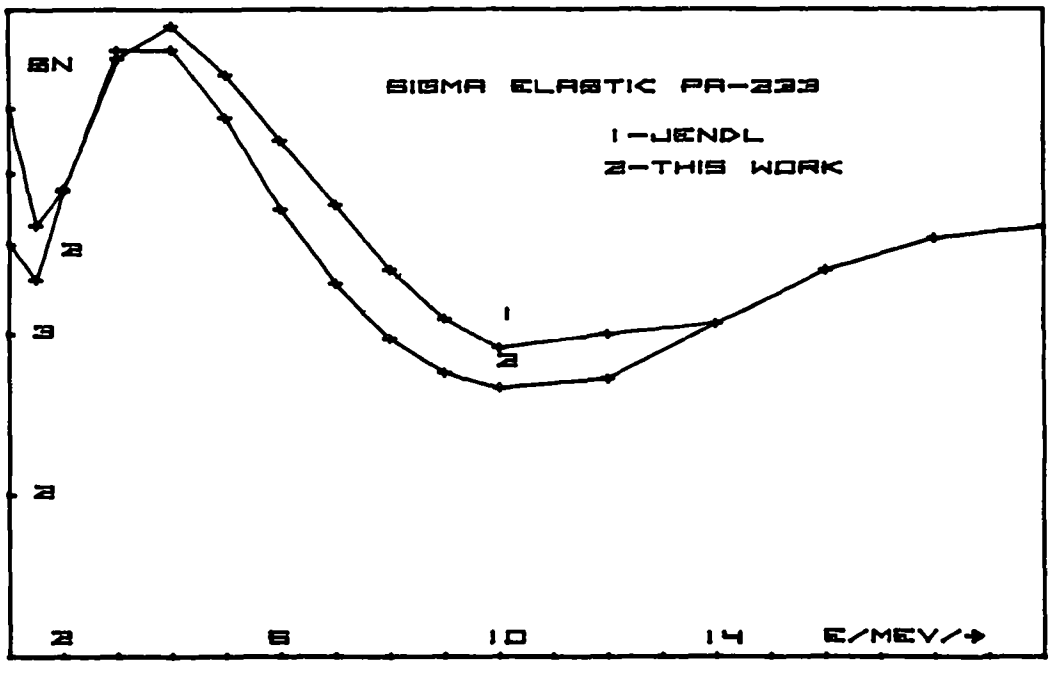

BN
SIGMA ELASTIC PA-233
1-JENDL
2-THIS WORK
2
3
2
1
2
2
6
10
14
E/MEV/→

FIG.7

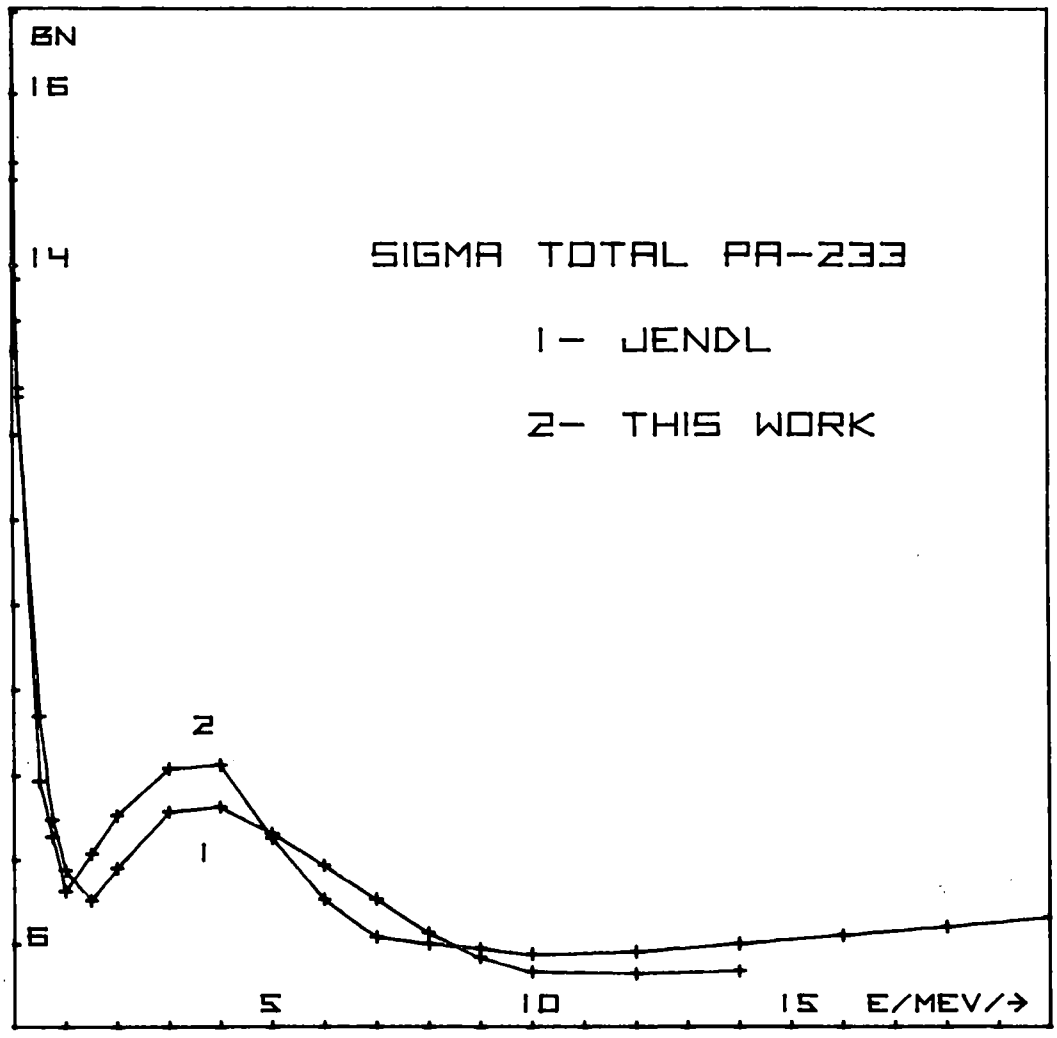


FIG. 8

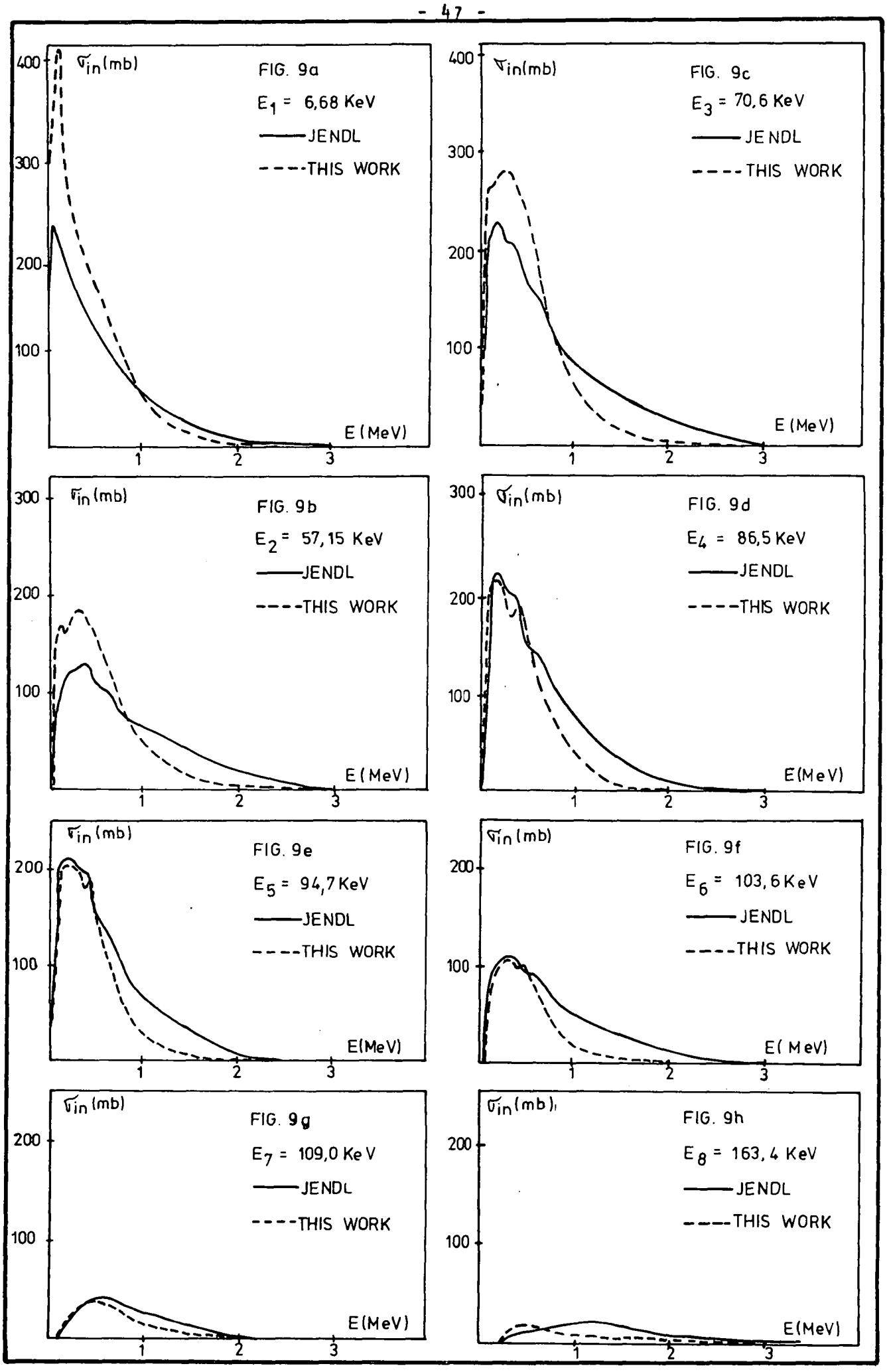
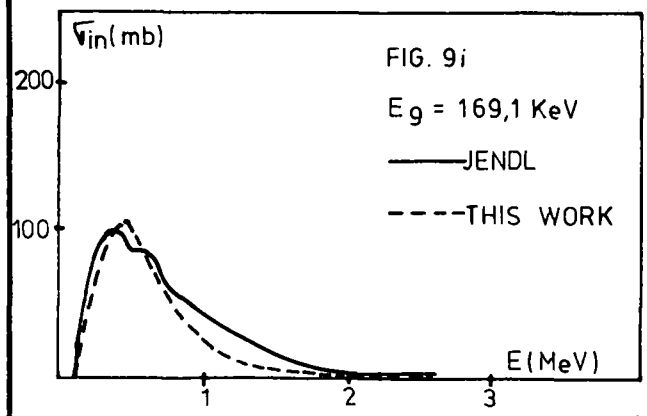
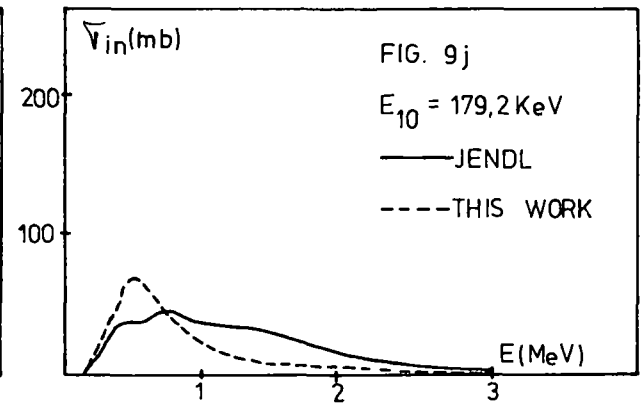
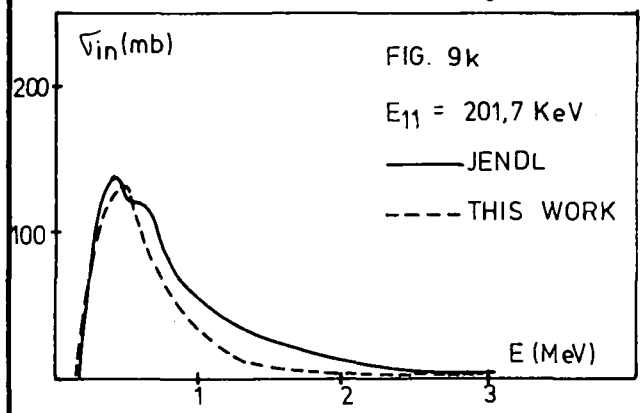
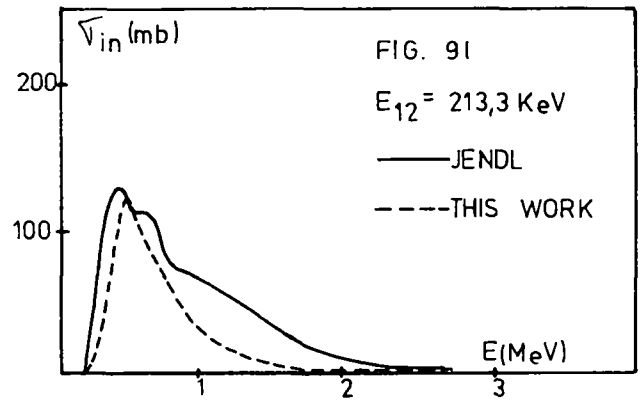


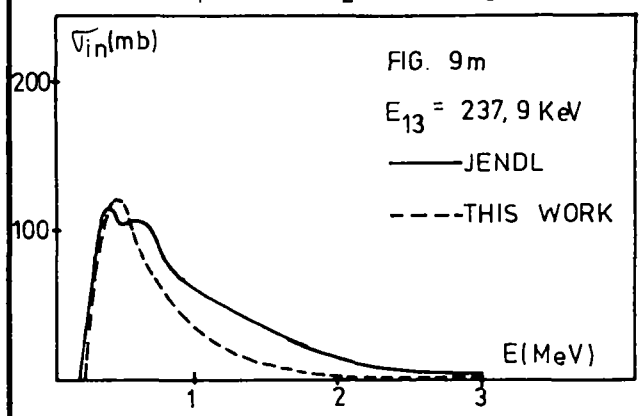
FIG. 9a
E1 = 6,68 KeV
JENDL
THIS WORK
σin (mb)
E (MeV)
FIG. 9b
E2 = 57,15 KeV
JENDL
THIS WORK
σin (mb)
E (MeV)
FIG. 9c
E3 = 70,6 KeV
JENDL
THIS WORK
σin (mb)
E (MeV)
FIG. 9d
E4 = 86,5 KeV
JENDL
THIS WORK
σin (mb)
E (MeV)
FIG. 9e
E5 = 94,7 KeV
JENDL
THIS WORK
σin (mb)
E (MeV)
FIG. 9f
E6 = 103,6 KeV
JENDL
THIS WORK
σin (mb)
E (MeV)
FIG. 9g
E7 = 109,0 KeV
JENDL
THIS WORK
σin (mb)
E (MeV)
FIG. 9h
E8 = 163,4 KeV
JENDL
THIS WORK
σin (mb)
E (MeV)

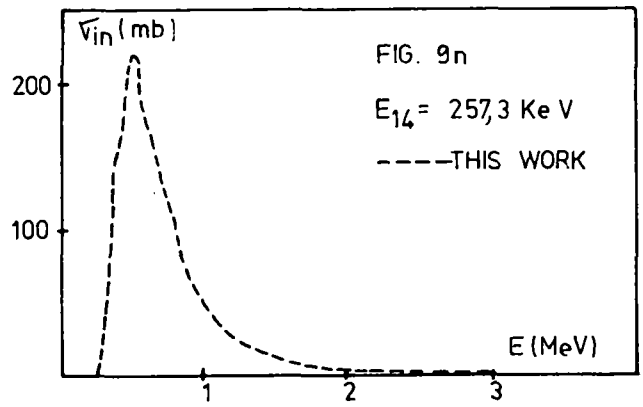

σin(mb)
FIG. 9i
E9 = 169,1 KeV
JENDL
THIS WORK
E(MeV)
200
100
1
2
3

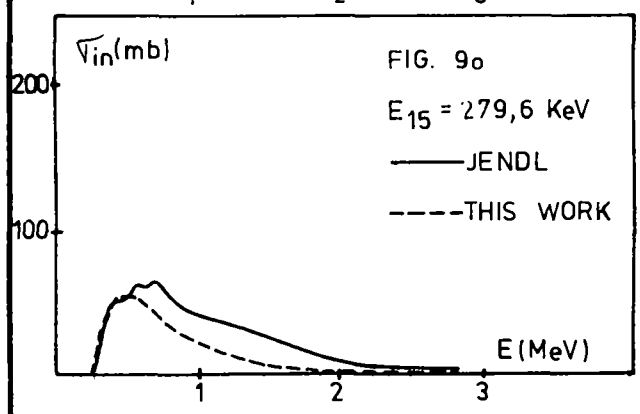

σin(mb)
FIG. 9j
E10 = 179,2 KeV
JENDL
THIS WORK
E(MeV)
200
100
1
2
3

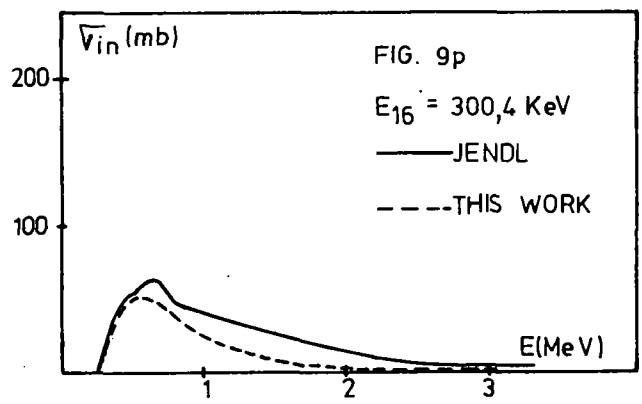

σin(mb)
FIG. 9k
E11 = 201,7 KeV
JENDL
THIS WORK
E (MeV)
200
100
1
2
3

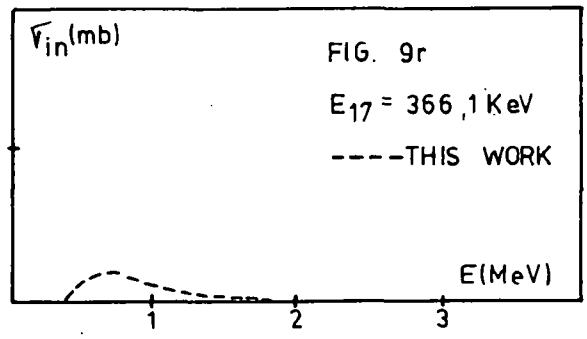

σin (mb)
FIG. 9l
E12 = 213,3 KeV
JENDL
THIS WORK
E(MeV)
200
100
1
2
3


σin(mb)
FIG. 9m
E13 = 237, 9 KeV
JENDL
THIS WORK
E(MeV)
200
100
1
2
3


σin (mb)
FIG. 9n
E14 = 257,3 Ke V
THIS WORK
E (MeV)
200
100
1
2
3


σin(mb)
FIG. 9o
E15 = 279,6 KeV
JENDL
THIS WORK
E(MeV)
200
100
1
2
3


σin (mb)
FIG. 9p
E16 = 300,4 KeV
JENDL
THIS WORK
E(MeV)
200
100
1
2
3


σin(mb)
FIG. 9r
E17 = 366,1 KeV
THIS WORK
E(MeV)
100
1
2
3

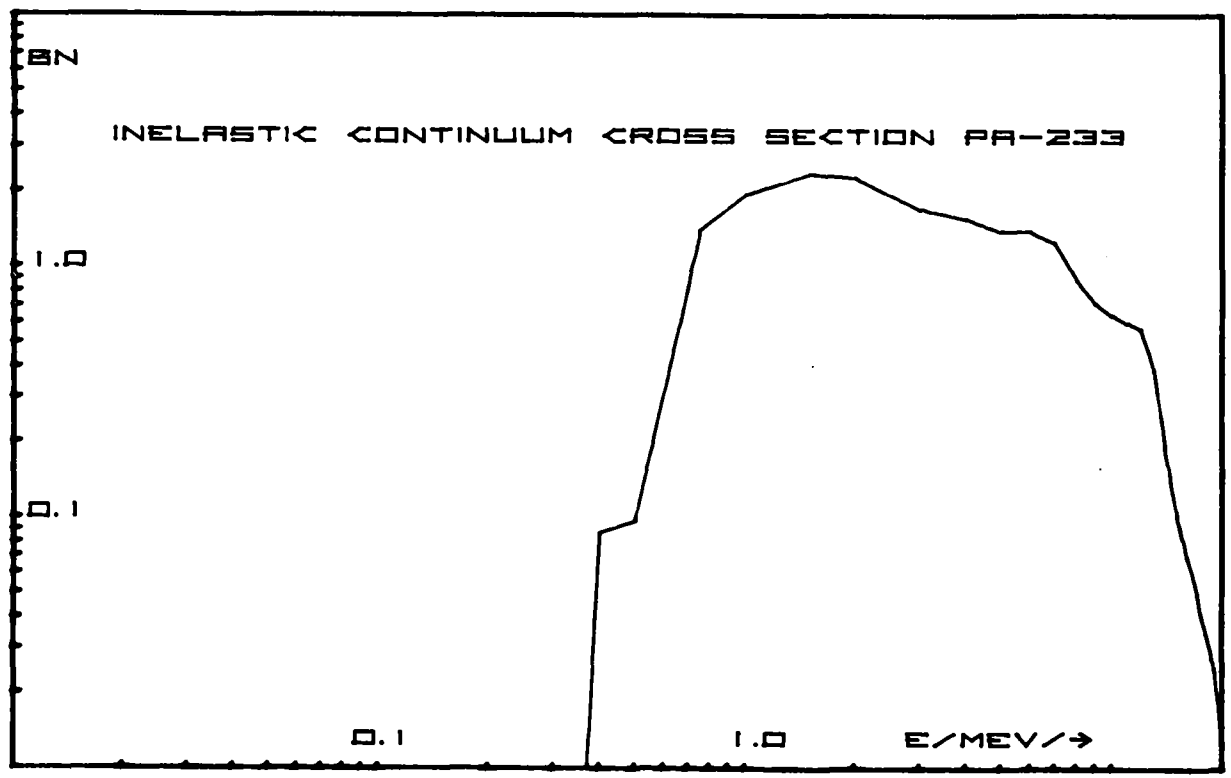


FIG.10

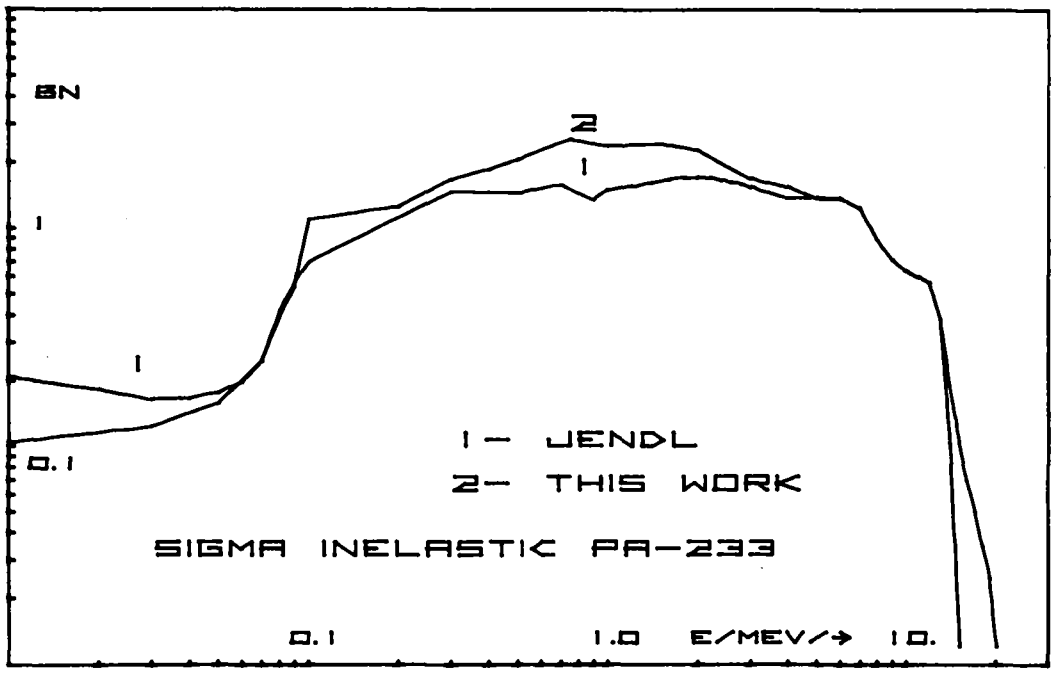

BN
2
1
1
1
0.1
1 — JENDL
2 — THIS WORK
SIGMA INELASTIC PA-233
0.1
1.0
E/MEV/→
10.

FIG. 11

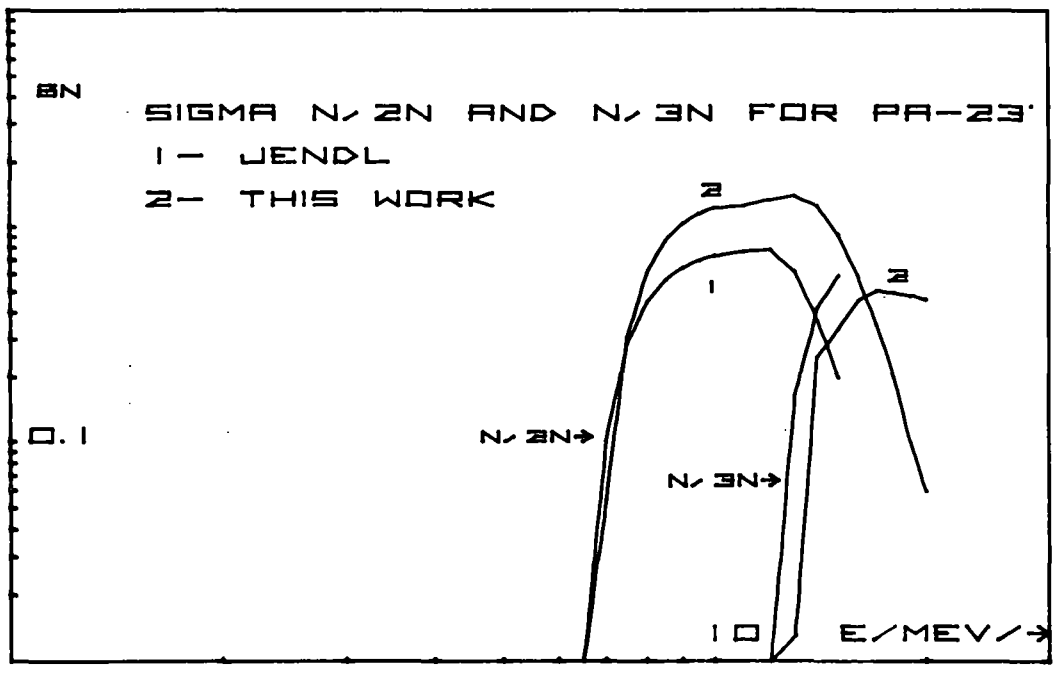

BN
SIGMA N/2N AND N/3N FOR PA-23
1 — JENDL
2 — THIS WORK
2
1
2
0.1
N/2N→
N/3N→
10
E/MEV/→

FIG. 14

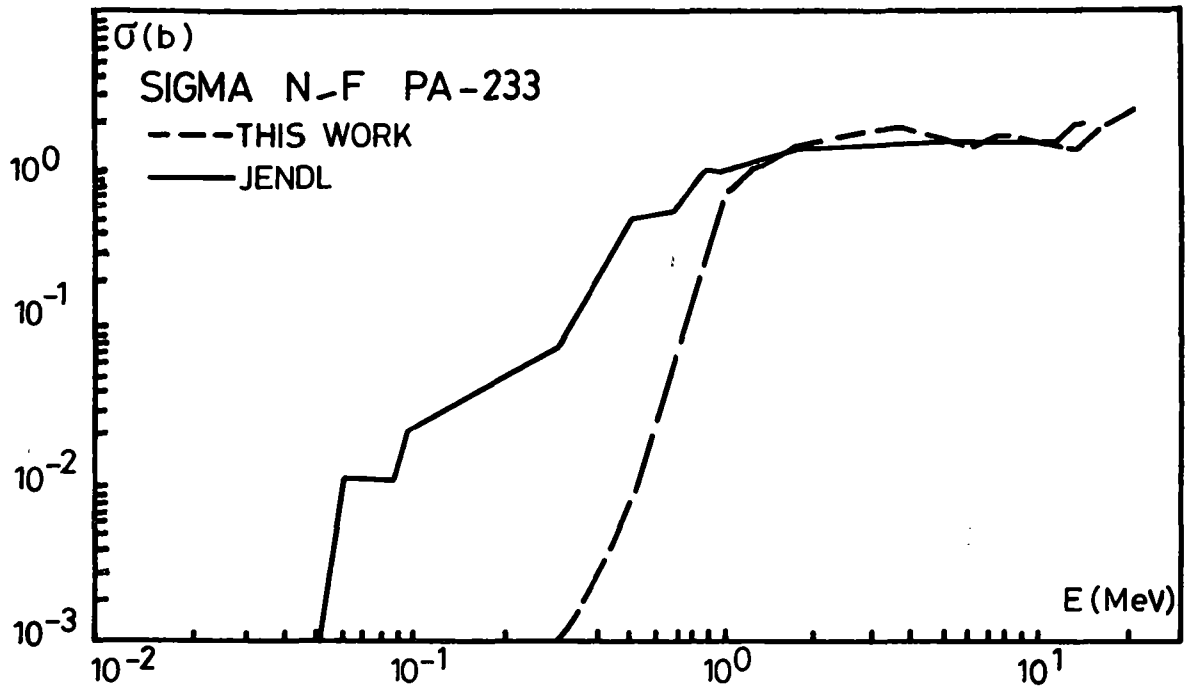

σ(b)
SIGMA N-F PA-233
THIS WORK
JENDL
10^0
10^-1
10^-2
10^-3
E (MeV)
10^-2
10^-1
10^0
10^1

Fig. 12

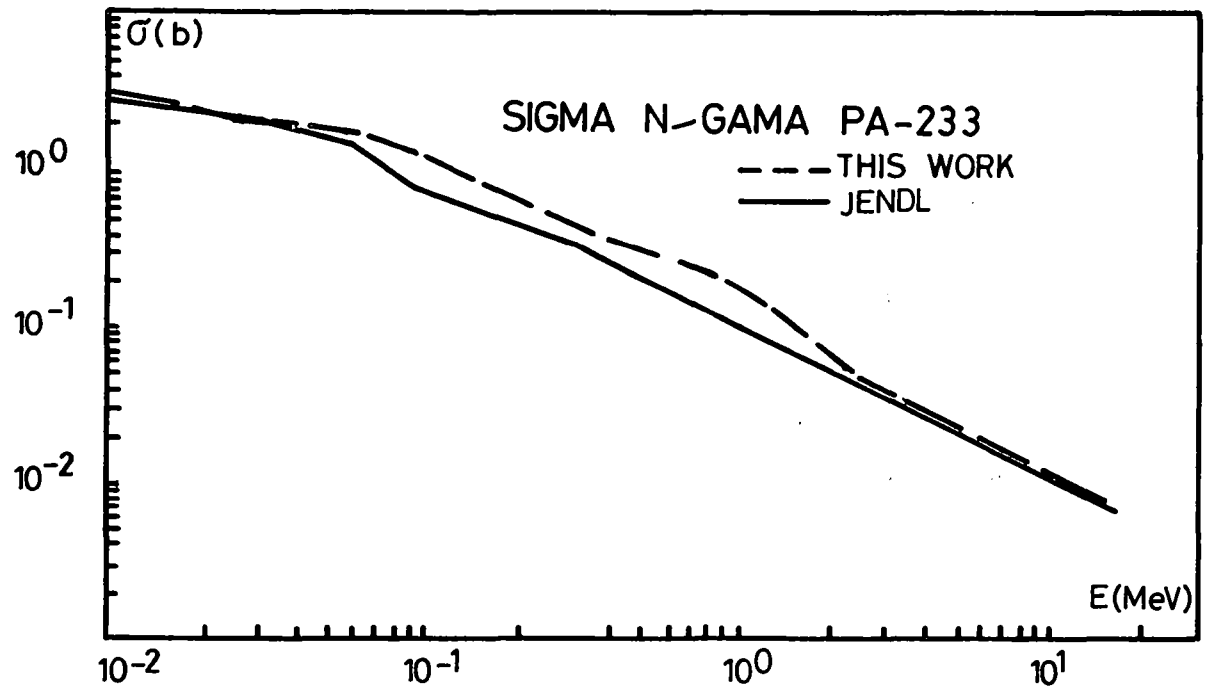

σ(b)
SIGMA N-GAMA PA-233
THIS WORK
JENDL
10^0
10^-1
10^-2
E(MeV)
10^-2
10^-1
10^0
10^1

Fig. 13

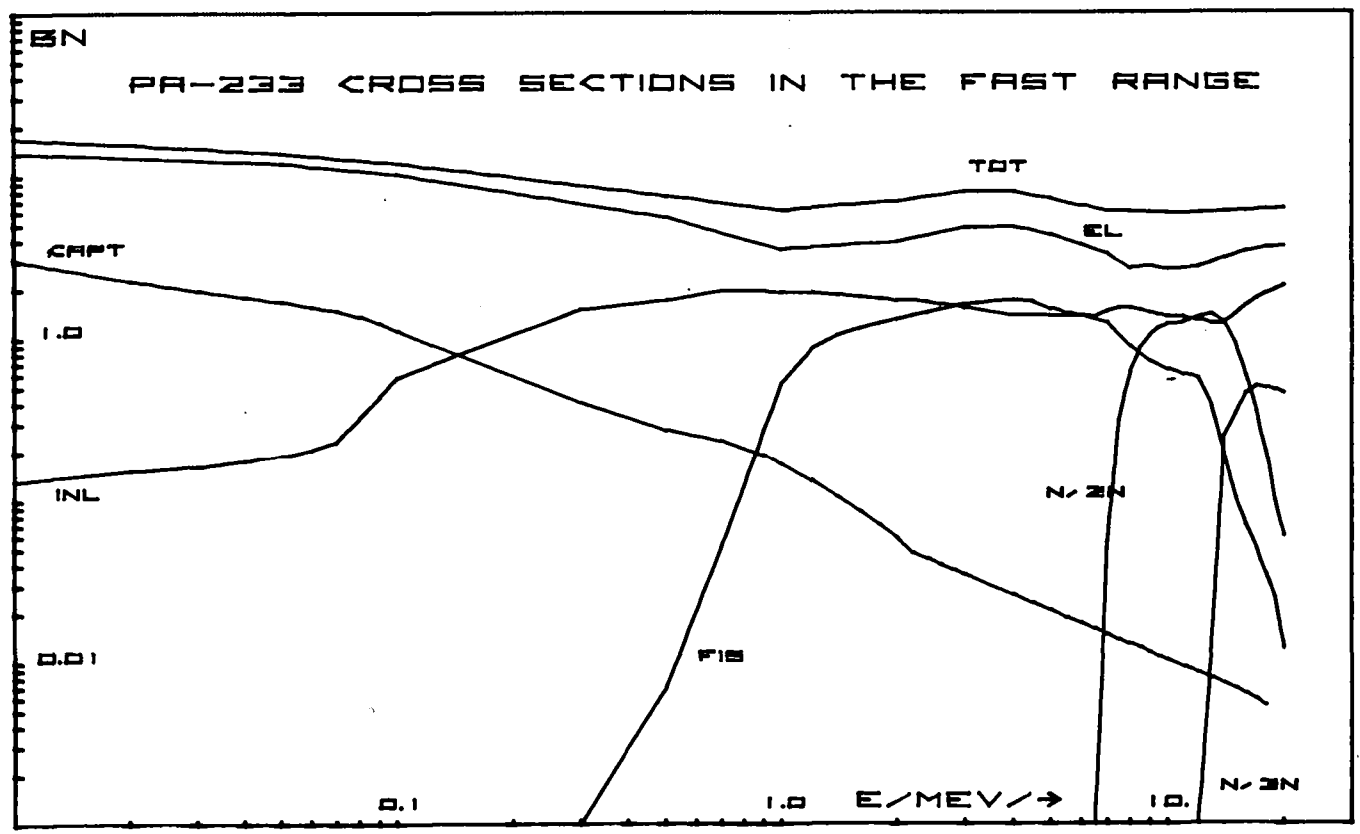

BN
PA-233 CROSS SECTIONS IN THE FAST RANGE
TOT
EL
CAPT
1.0
INL
N/2N
0.01
FIS
0.1
1.0
E/MEV/→
10.
N/3N

FIG. 15

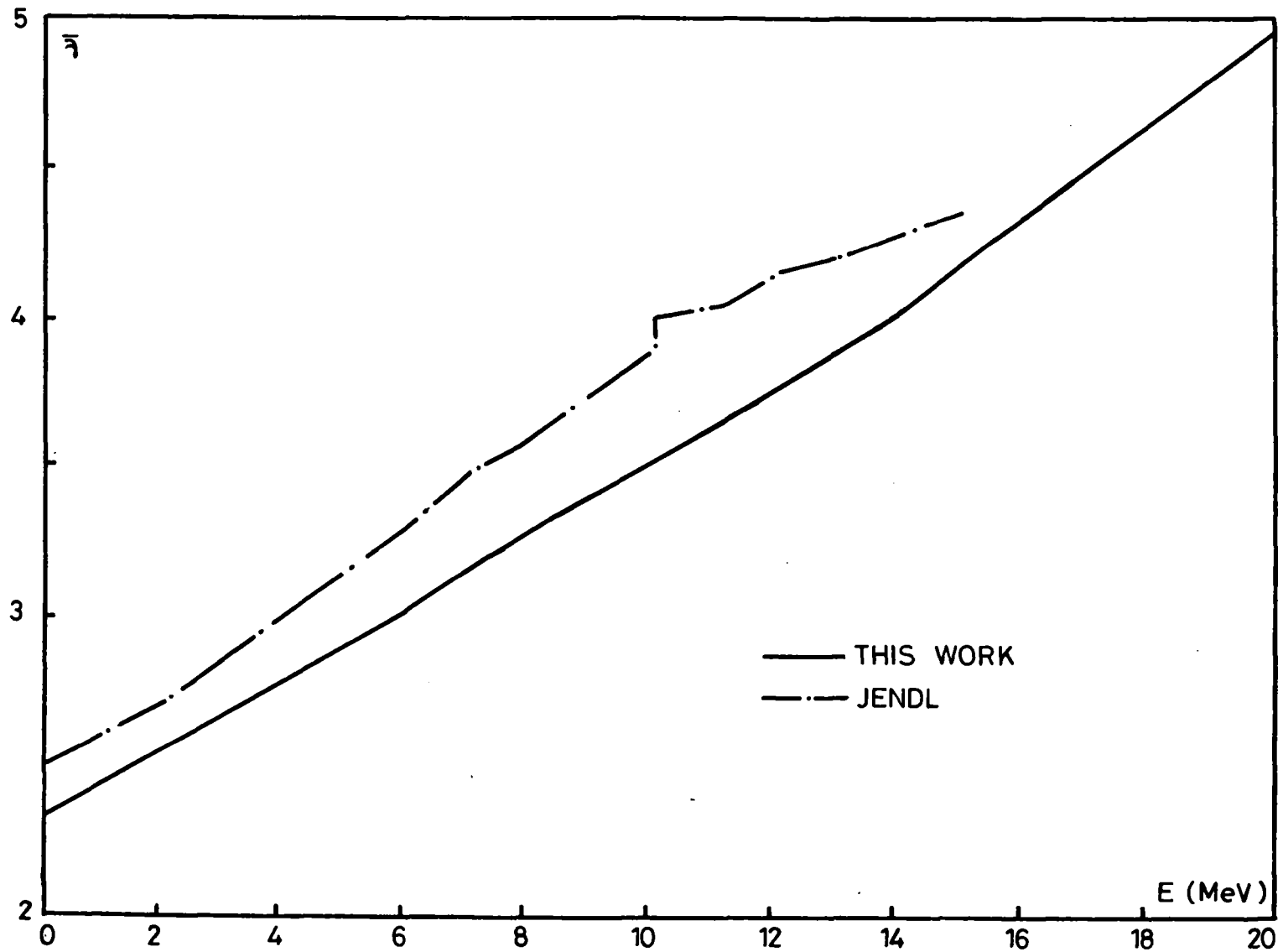


Fig. 16

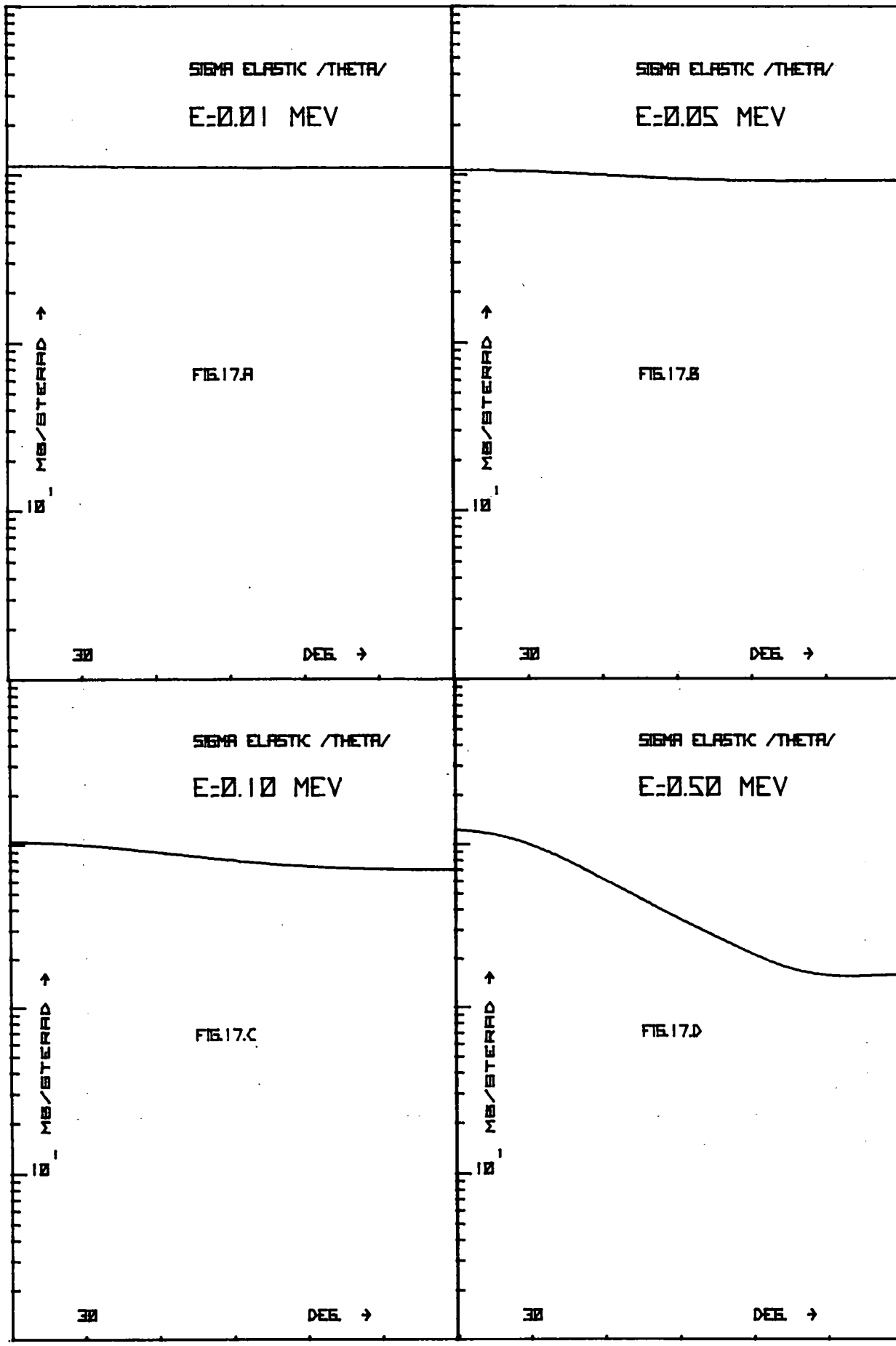


FIG.17.A FIG.17.B FIG.17.C FIG.17.D

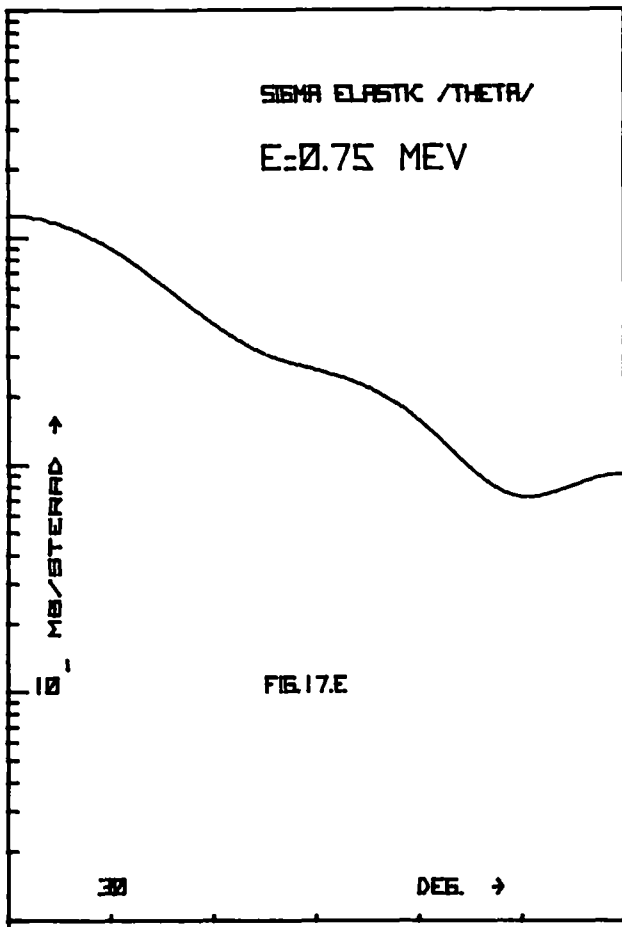


FIG.17.E

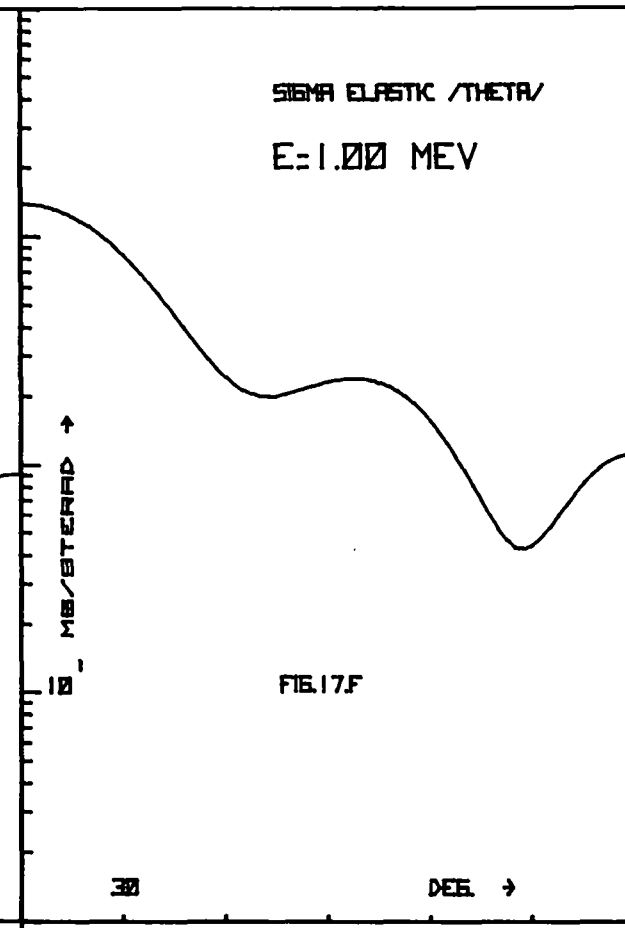


FIG.17.F

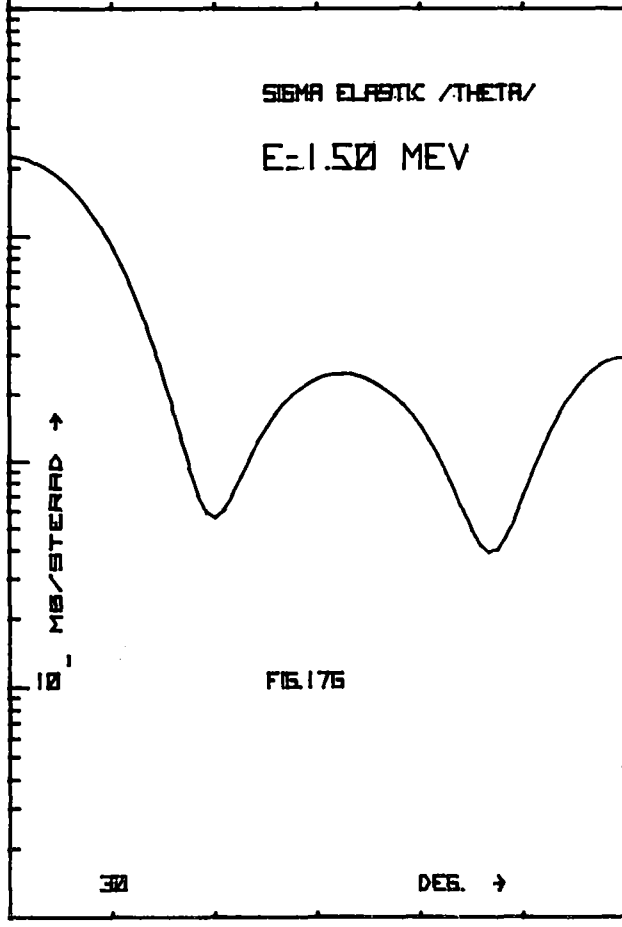


FIG.17G

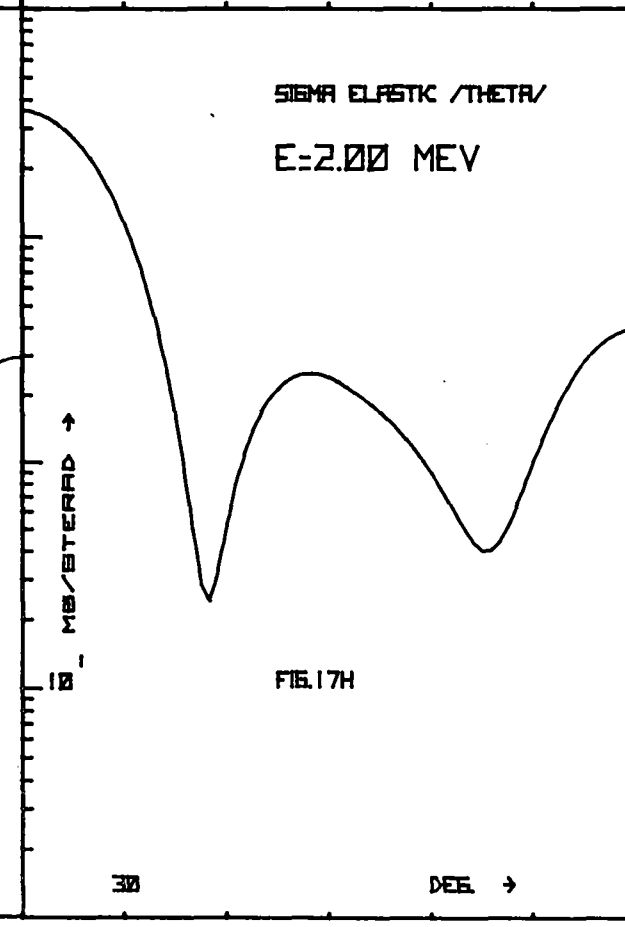


FIG.17H

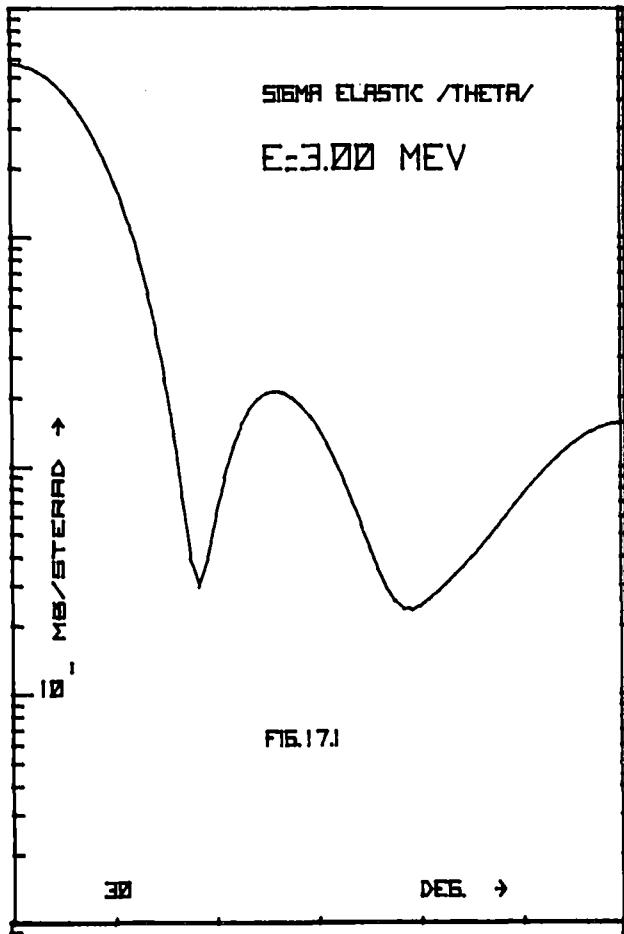


FIG.17.I

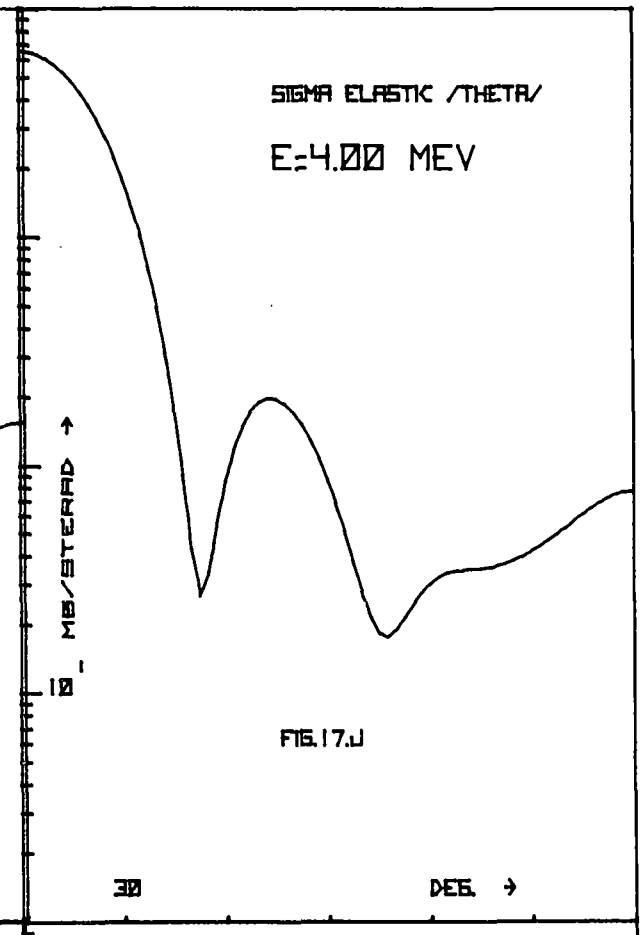


FIG.17.J

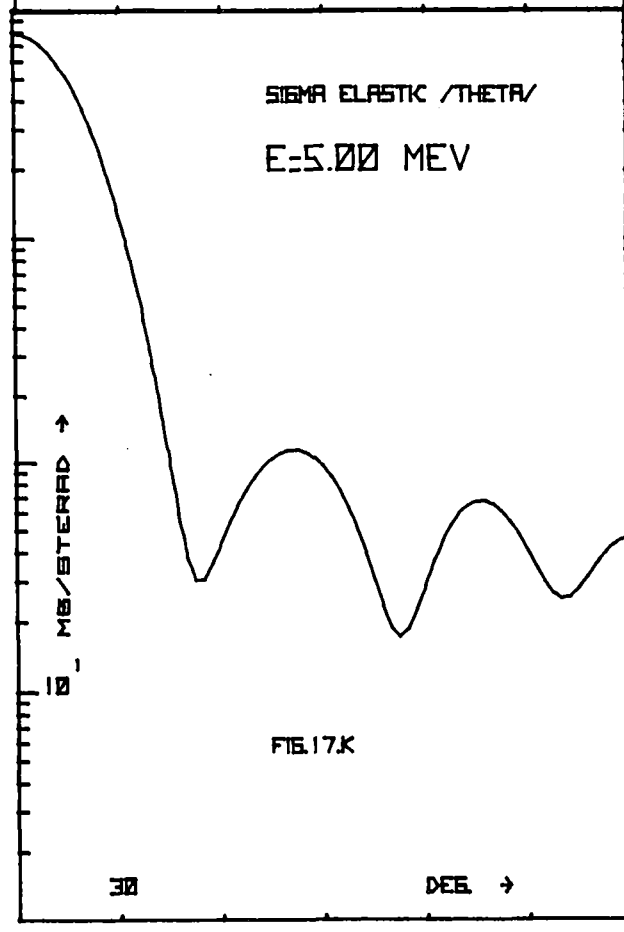


FIG.17.K

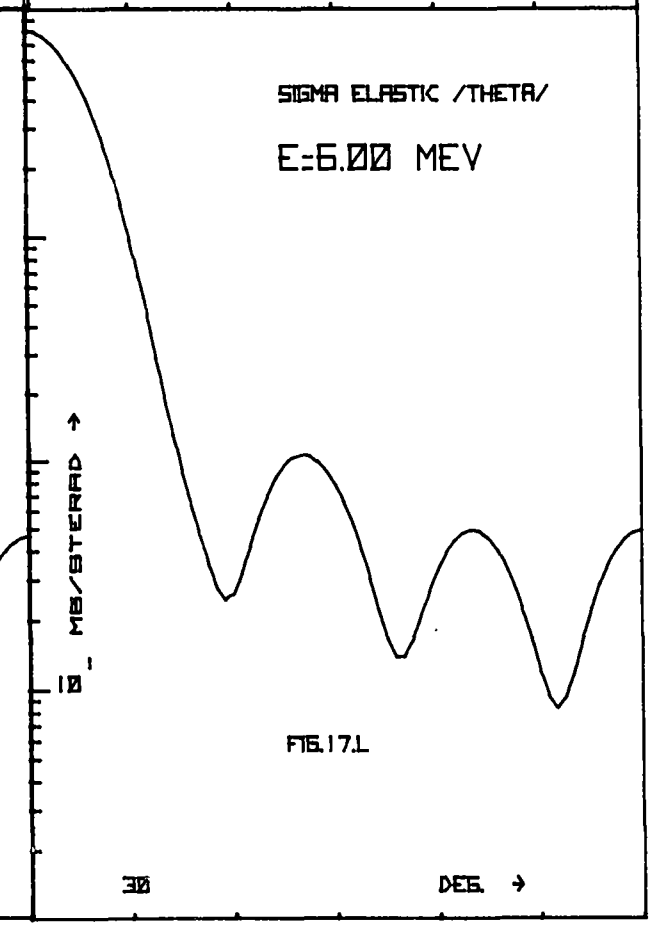


FIG.17.L

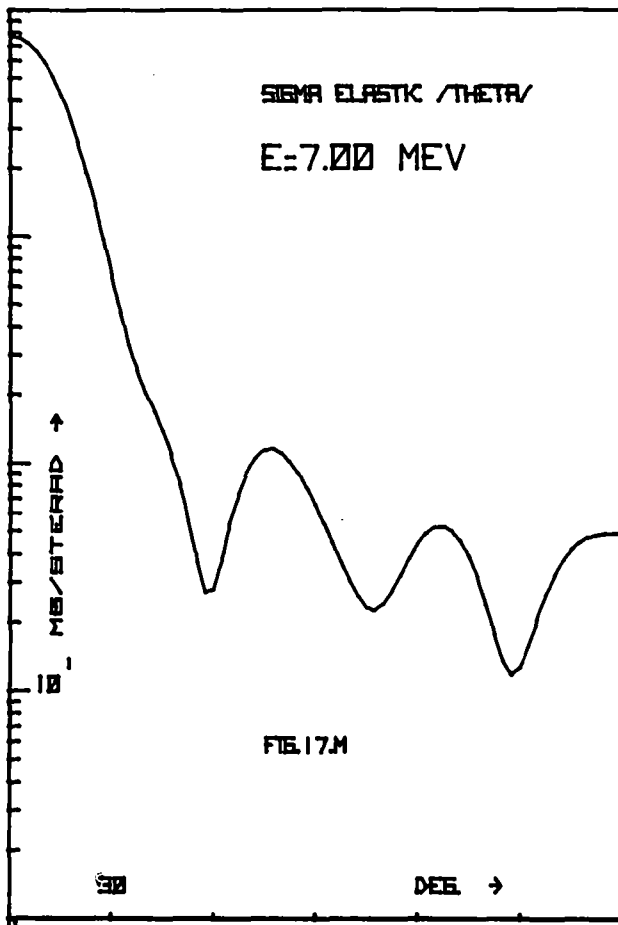


FIG.17.M

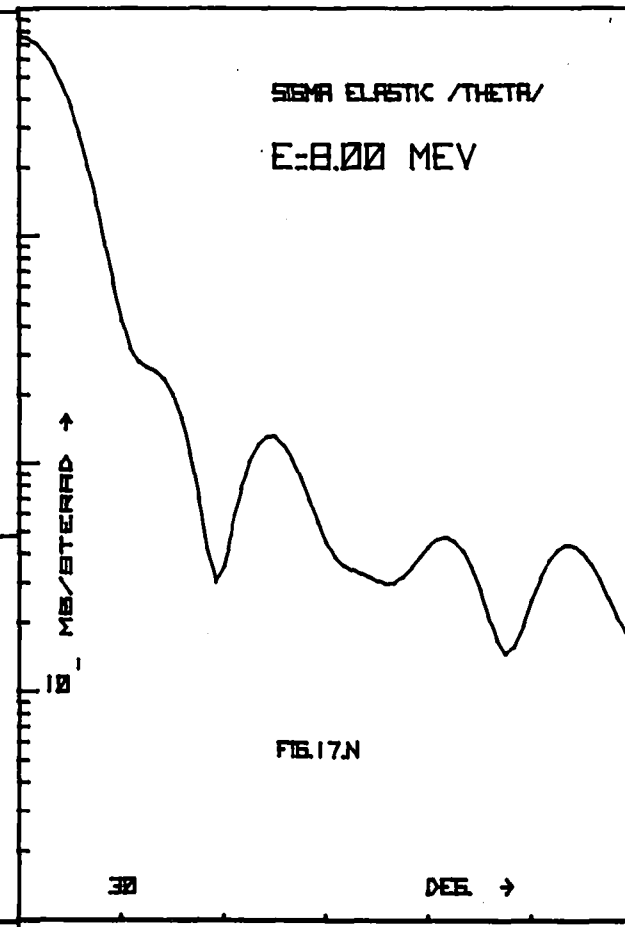


FIG.17.N

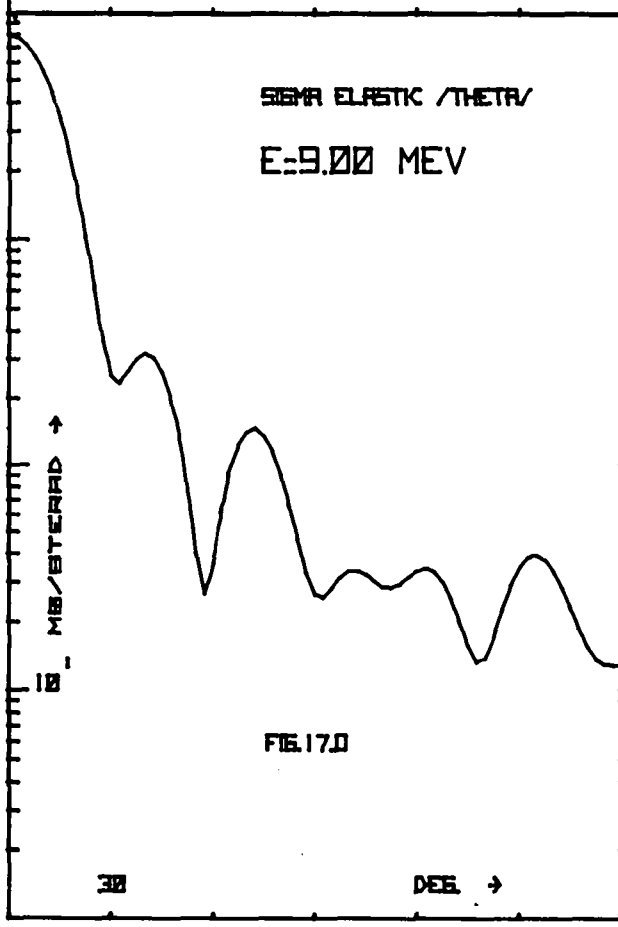


FIG.17.O

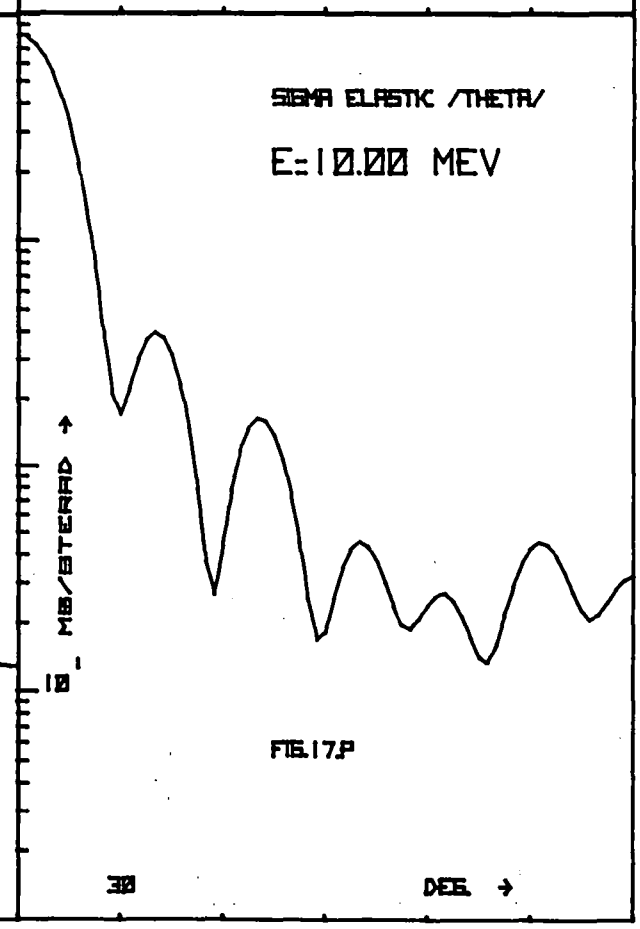
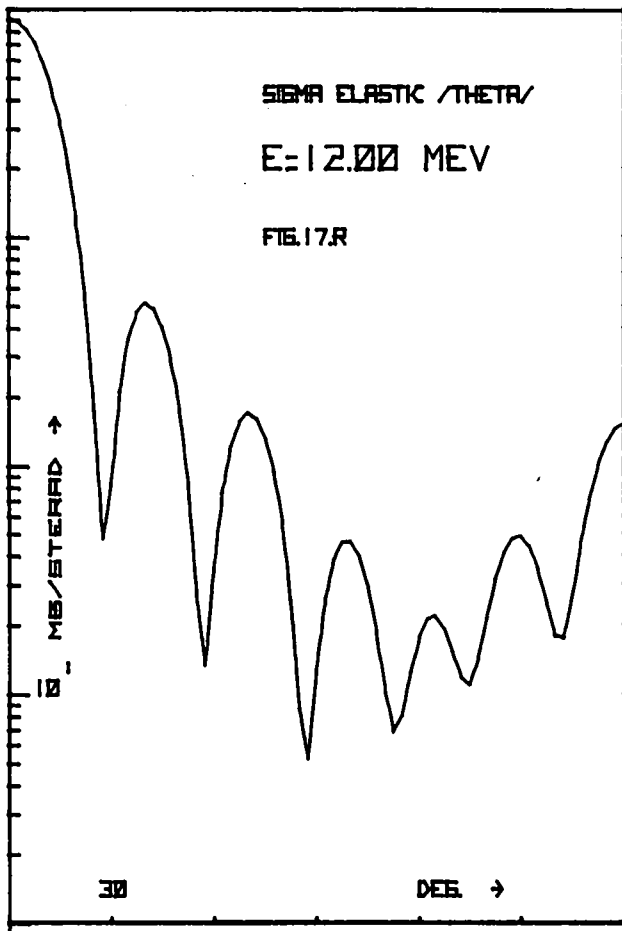
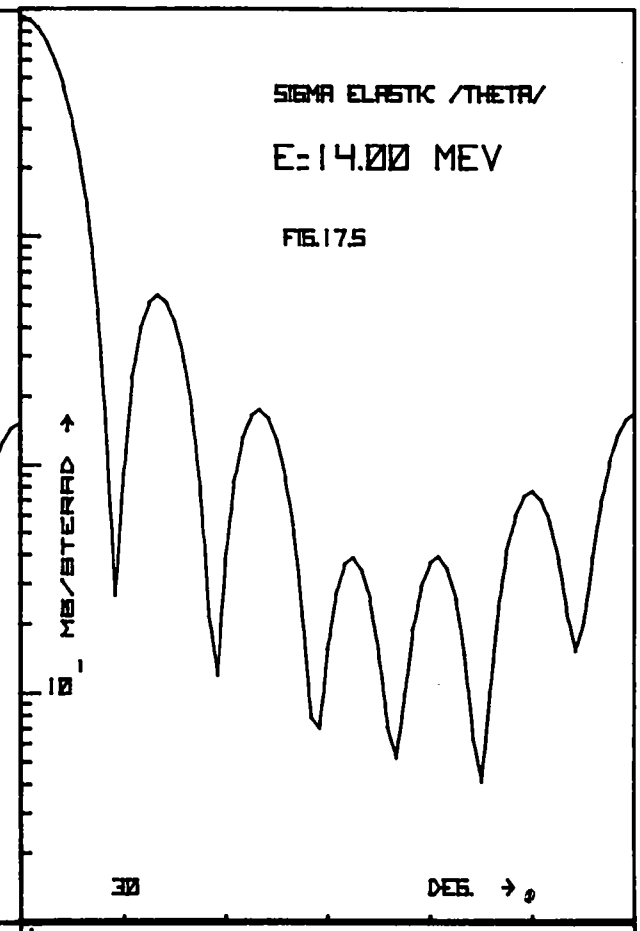
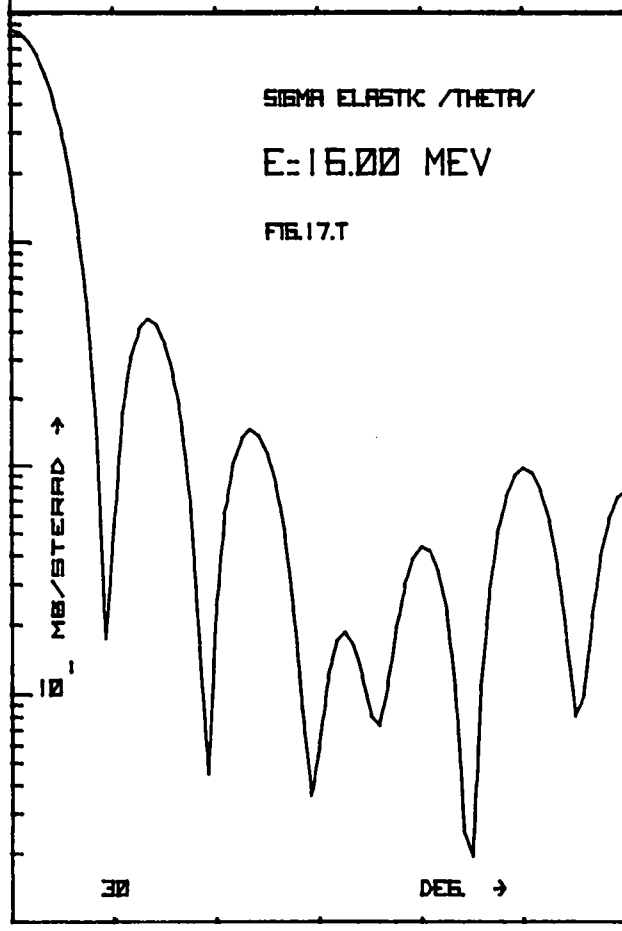
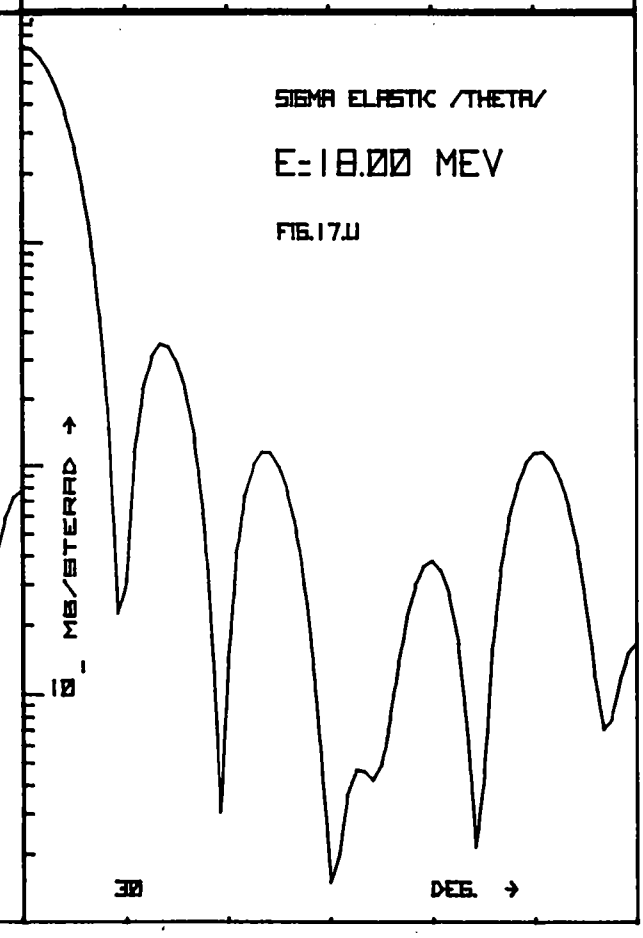


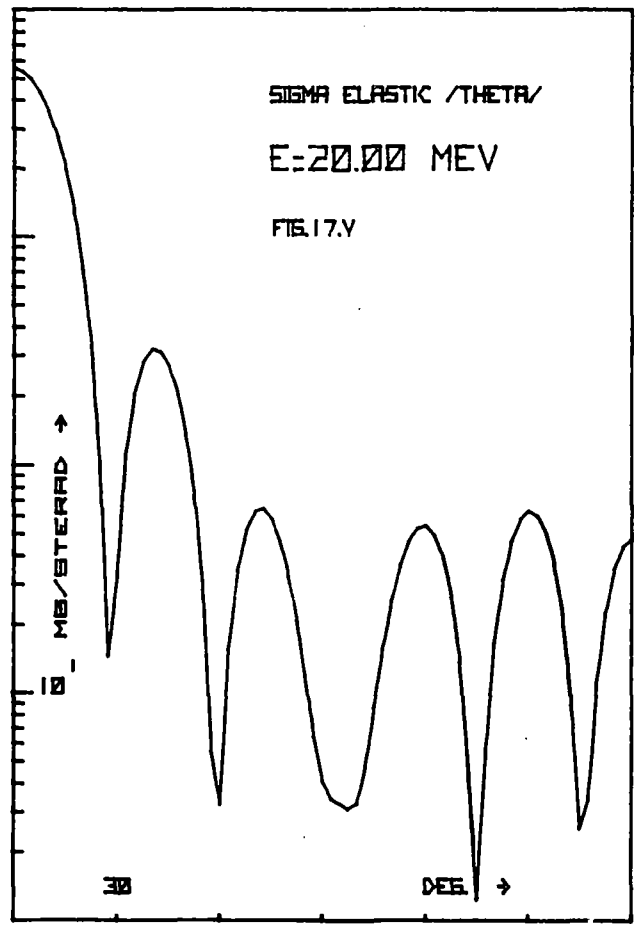
FIG.17.P


SIGMA ELASTIC /THETA/
E=12.00 MEV
FIG.17.R
MB/STERRAD →
10⁻¹
30
DEG. →


SIGMA ELASTIC /THETA/
E=14.00 MEV
FIG.17.S
MB/STERRAD →
10⁻¹
30
DEG. →


SIGMA ELASTIC /THETA/
E=16.00 MEV
FIG.17.T
MB/STERRAD →
10⁻¹
30
DEG. →


SIGMA ELASTIC /THETA/
E=18.00 MEV
FIG.17.U
MB/STERRAD →
10⁻¹
30
DEG. →


SIGMA ELASTIC /THETA/
E=20.00 MEV
FIG.17.V
MB/STERRAD →
10
30
DEG. →

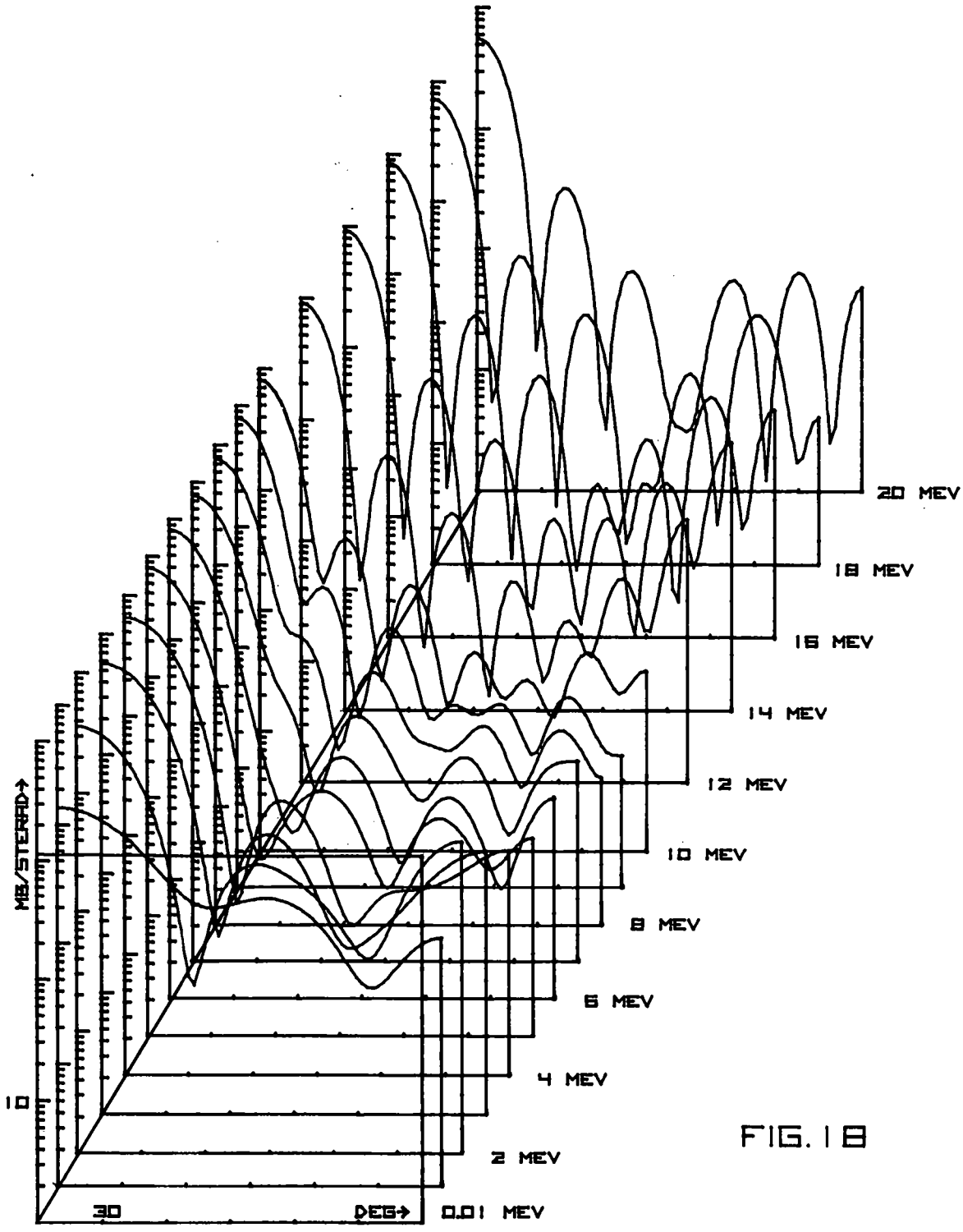

MB/STERRAD→
10
30
DEG→
0.01 MEV
2 MEV
4 MEV
6 MEV
8 MEV
10 MEV
12 MEV
14 MEV
16 MEV
18 MEV
20 MEV

FIG. 18

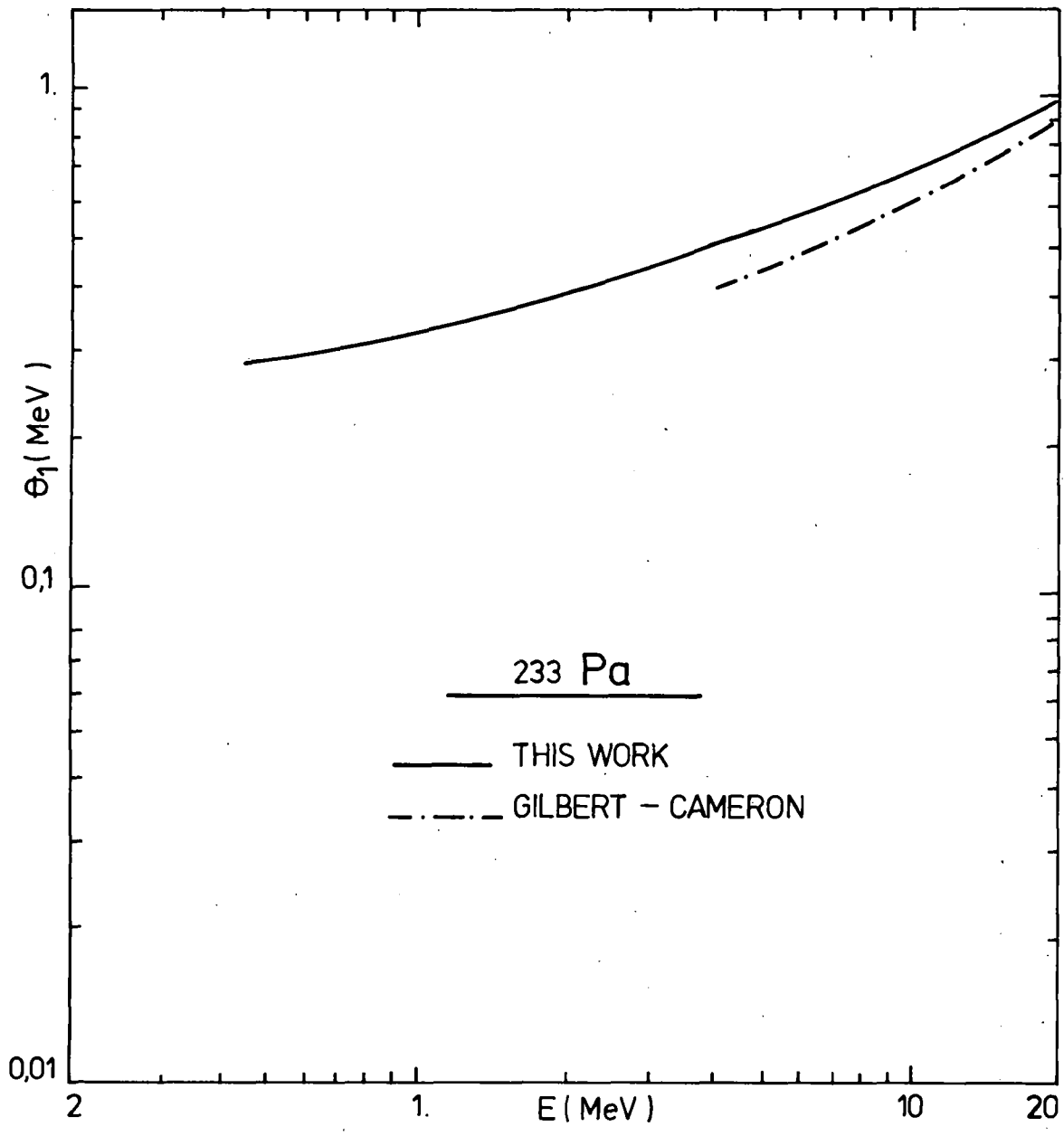

1.
0,1
0,01
Θ_1 (MeV)
2
1.
E (MeV)
10
20
233 Pa
THIS WORK
GILBERT – CAMERON

FIG. 19

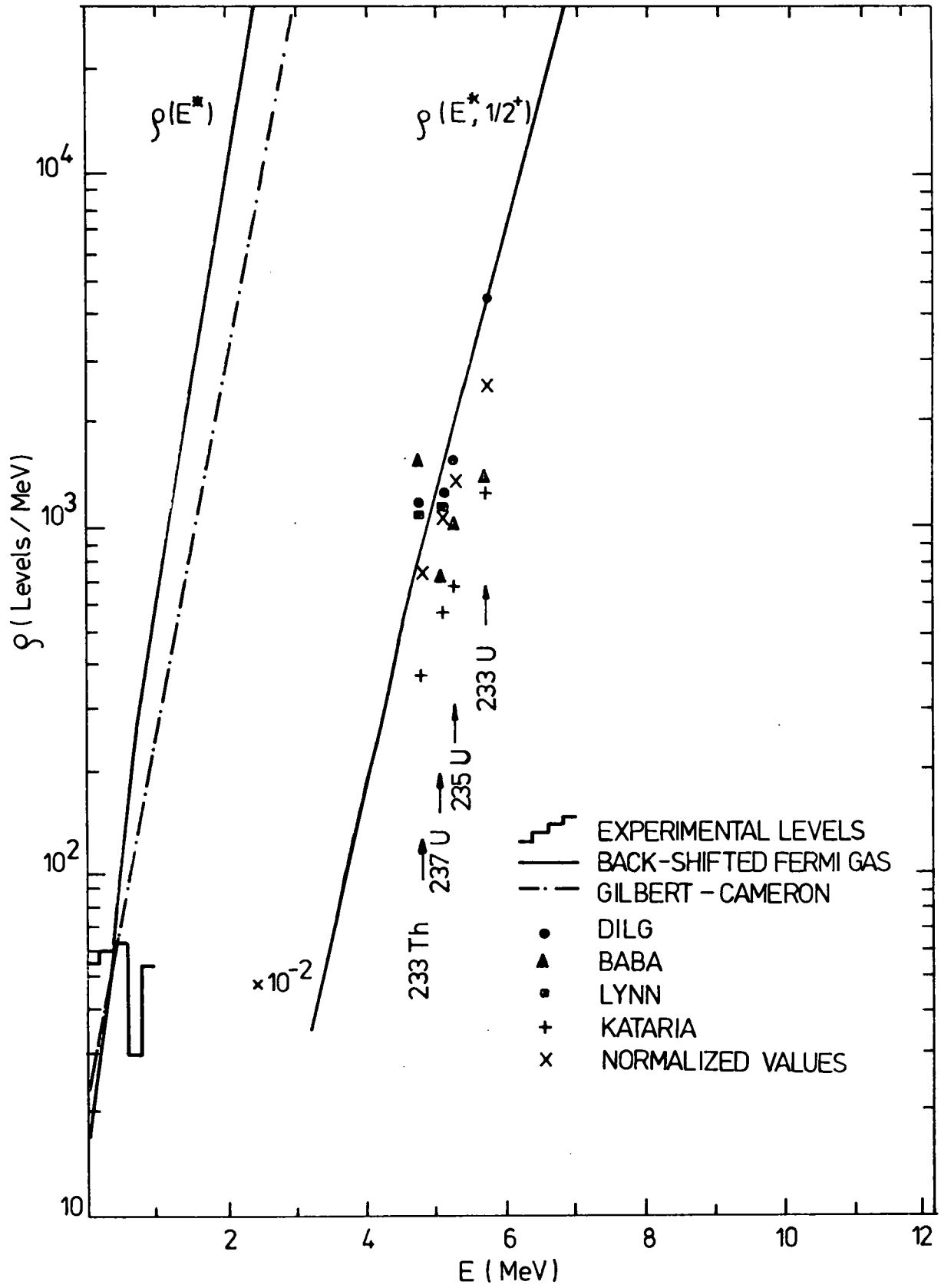

ρ(E*)
ρ(E*, 1/2+)
×10^-2
233 Th
237 U
235 U
233 U
EXPERIMENTAL LEVELS
BACK-SHIFTED FERMI GAS
GILBERT - CAMERON
DILG
BABA
LYNN
KATARIA
NORMALIZED VALUES
ρ (Levels / MeV)
E (MeV)
10
10^2
10^3
10^4
2
4
6
8
10
12

FIG. 20

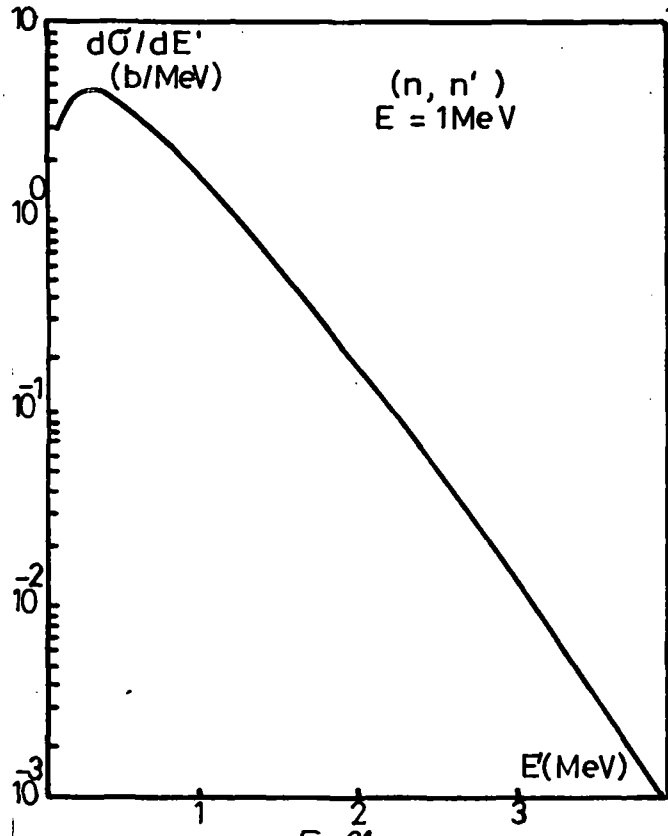


Fig. 21

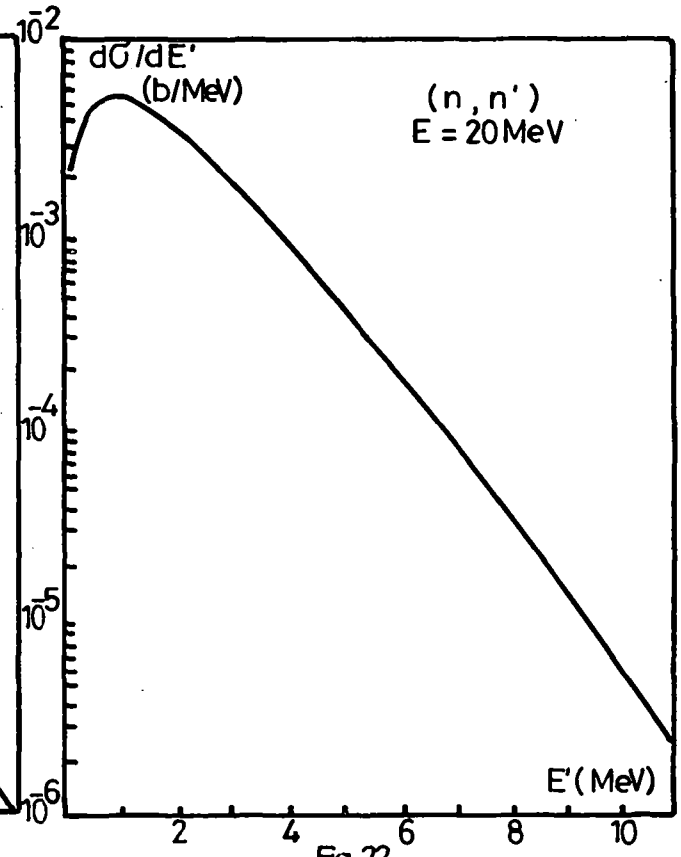


Fig. 22

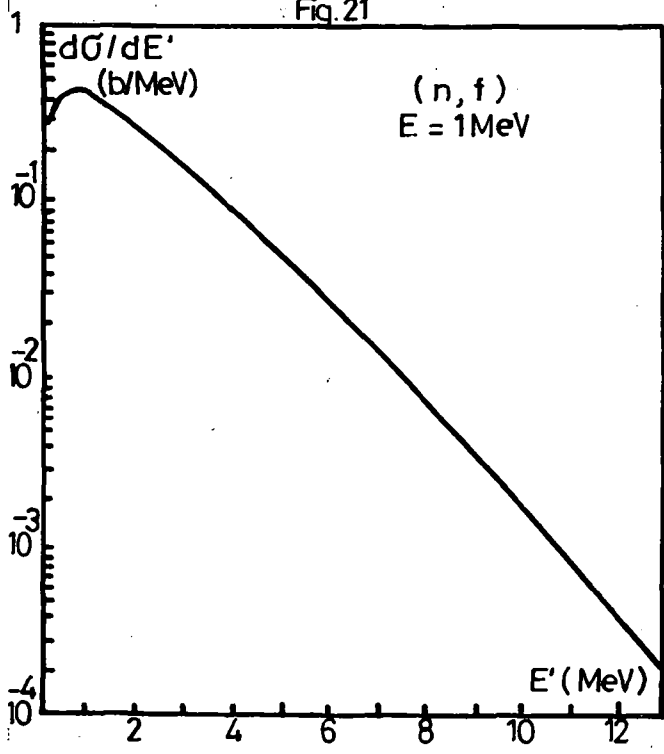


Fig. 23

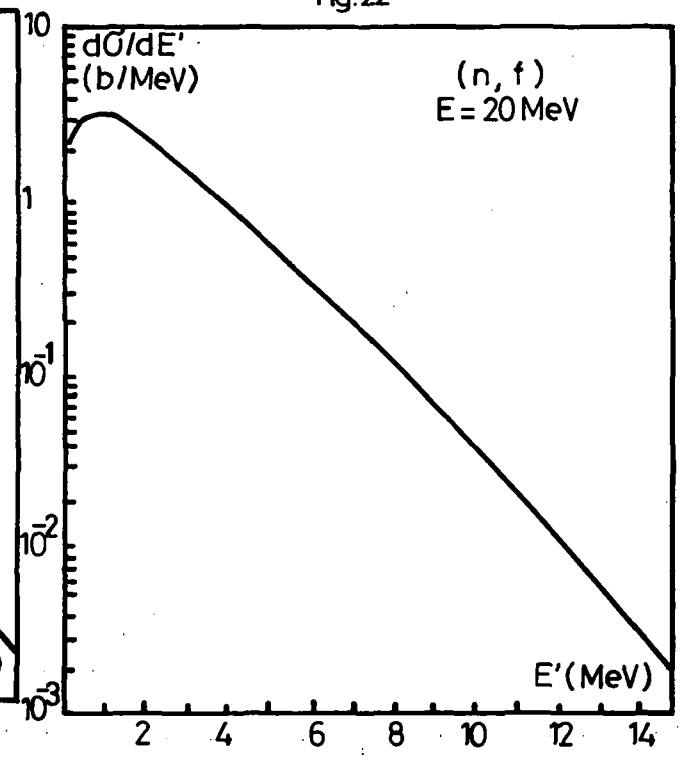


Fig. 24

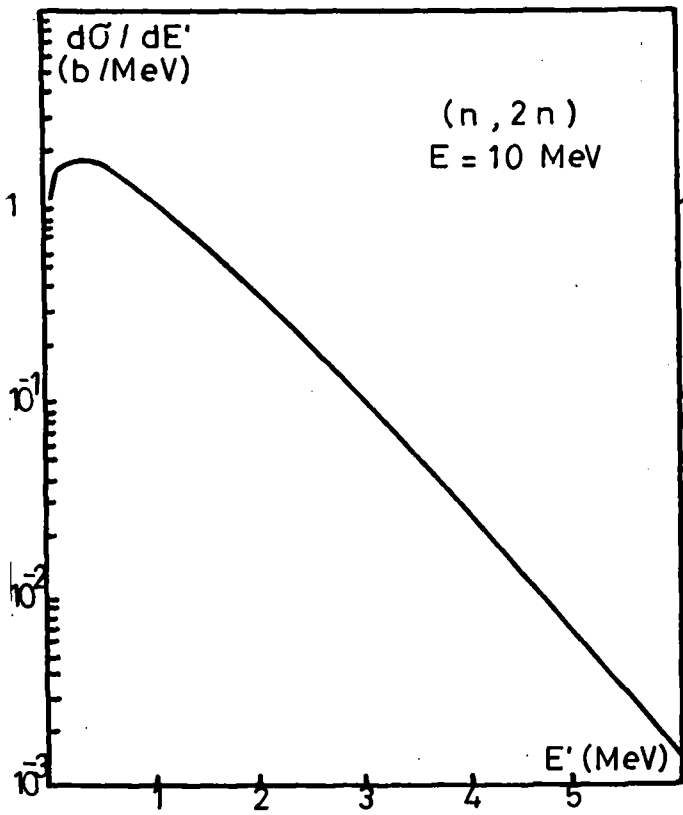


Fig. 25

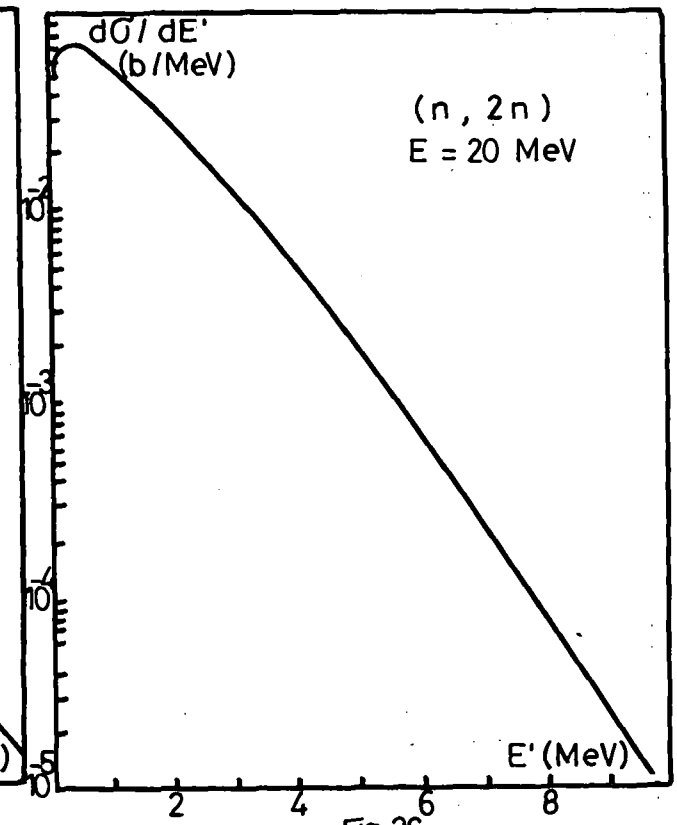


Fig. 26

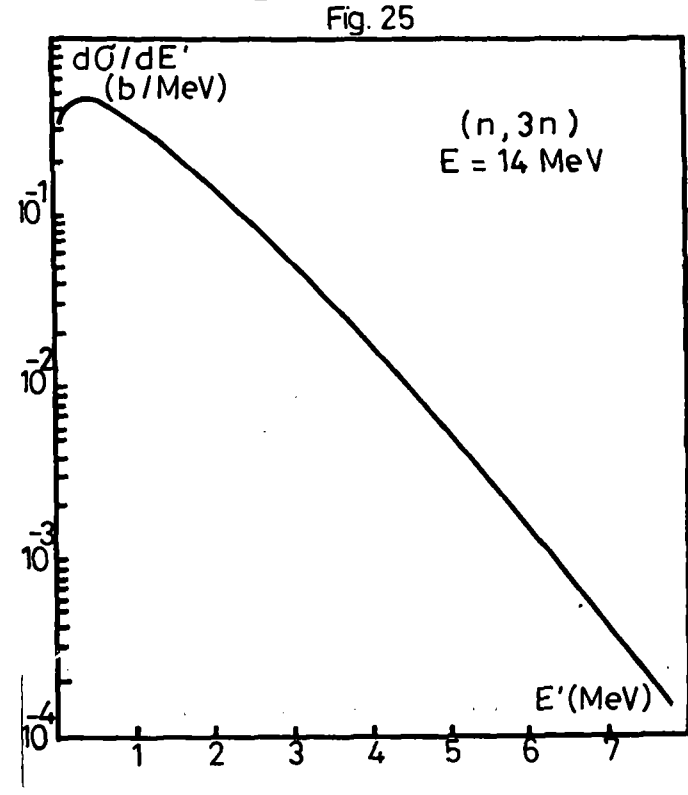


Fig. 27

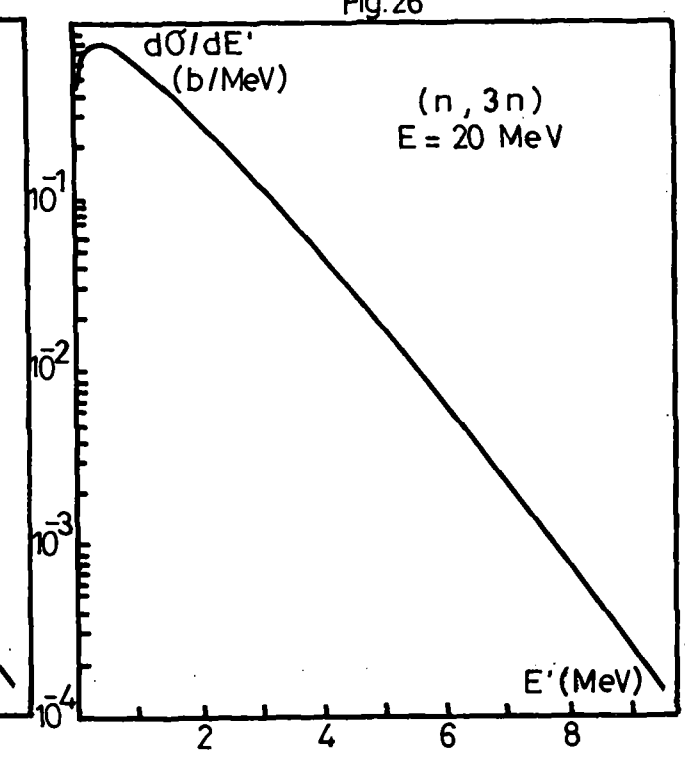


Fig. 28

A P P E N D I X

```
                                                                    100 0  0
9.12330+04 2.31038+02          1          1                     558888 1451
                               1                   77             8888 1451
    ***********************************************************  8888 1451
    *                                                         *  8888 1451
    *            *******     91-PA-233      *******            *  8888 1451
    *                                                         *  8888 1451
    *    THIS EVALUATION WAS MADE IN THE FRAMEWORK OF THE RES-  *  8888 1451
    *    SEARCH CONTRACT NO.2061/RB BY:G.VASILIU,S.MATEESCU,    *  8888 1451
    *    S.RAPEANU,V.AVRIGEANU,M.CIOCARU,N.DRAGAN,T.STADNICOV   *  8888 1451
    *    O.BUJOREANU.                                           *  8888 1451
    *                                                         *  8888 1451
    *      INSTITUTE OF NUCLEAR POWER REACTORS,MAY,1980.        *  8888 1451
    *                      PITESTI-ROMANIA                    *  8888 1451
    *                                                         *  8888 1451
    ***********************************************************  8888 1451
                                                                   8888 1451
*****    THE EXPERIMENTAL DATA WERE AVAILABLE FOR TOTAL CROSS      8888 1451
         SECTION ONLY,FROM EXFOR LIBRARY.                          8888 1451
                                                                   8888 1451
*****    THE DECAY DATA WERE BASED ON REFERENCES:/1/,/2/,/3/.      8888 1451
                                                                   8888 1451
*****    THE TOTAL,ELASTIC,AND CAPTURE CROSS SECTIONS WERE EVALU-8888 1451
         ATED IN THE THERMAL AND RESOLVED RESONANCES REGIONS       8888 1451
         /0-38.5EV/ BASED ON REFERENCES /4/,/5/. THE CROSS SECTI-8888 1451
         ONS ARE CALCULATED BY ETRES /6/ CODE.                     8888 1451
                                                                   8888 1451
*****    THE TOTAL,ELASTIC,AND CAPTURE CROSS SECTIONS IN THE UN-   8888 1451
         RESOLVED RESONANCES REGION /38.5EV-10KEV/ WERE CALCULA-   8888 1451
         TED BY AVERAGE-3/7/ CODE FROM AVERAGED PARAMETERS.        8888 1451
                                                                   8888 1451
*****    IN THE FAST REGION /10KEV-20MEV/ THE TOTAL AND ELASTIC    8888 1451
         CROSS SECTIONS HAVE BEEN CALCULATED BY OPTICAL AND STA-   8888 1451
         TISTICAL MODELS WITH ELIESE /8/ AND JUPITOR /9/ CODES.    8888 1451
         THE FISSION,RADIATIVE CAPTURE CROSS SECTI-                8888 1451
         ONS UP TO 4MEV HAVE BEEN COMPUTED BY STATISTICAL MODEL ,8888 1451
         AND FISSION(>4MEV),(N,2N),(N,3() CROSS SECTIONS ,BY EVA-8888 1451
         PORATION MODEL,WITH STATMOD /10/ AND MASTER /11/ CODES.   8888 1451
                                                                   8888 1451
*****    THE INELASTIC CROSS SECTIONS ON EXCITED LEVELS AND THE    8888 1451
         TOTAL INELASTIC CROSS SECTION WERE CALCULATED BY ELIESE   8888 1451
         PROGRAMME.                                                8888 1451
                                                                   8888 1451
*****    THE AVERAGED NUMBER OF NEUTRON EMMITTED PER FISSION WAS   8888 1451
         EVALUATED FROM HOWERTON'S SYSTEMATICS /12/.               8888 1451
                                                                   8888 1451
*****    THE ELASTIC ANGULAR DISTRIBUTIONS ARE EXPRESSED BY NOR-   8888 1451
         MALIZED COEFFICIENTS OF LEGENDRE POLYNOMIALS.             8888 1451
         THE TRANSFORMATION MATRIX FROM CM TO LAB SYSTEM IS GIVEN8888 1451
         THE CALCULATIONS ARE EFFECTUATED  BY SAD /13/ CODE.       8888 1451
                                                                   8888 1451
*****    THE ANGULAR DISTRIBUTIONS FOR SECONDARY NEUTRONS FROM     8888 1451
         (N,2N),(N,3N),FISSION REACTIONS,AS WELL AS FOR INELAS-    8888 1451
         TIC SCATTERING ON EXCITED LEVELS AND ON CONTINUUM ARE     8888 1451
         CONSIDERED ISOTROPIC DISTRIBUTED.                         8888 1451
                                                                   8888 1451
*****    THE ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS FROM INE-8888 1451
         LASTIC SCATTERING ARE EVALUATED BY EVAPORATION MODEL ,    8888 1451
         BY LEVEL DENSITY EVALUATION FROM BACK-SHIFTED FERMI GAS   8888 1451
         MODEL. FOR (N,2N) AND (N,3N) REACTIONS ,THE NEUTRON CAS-8888 1451
         CADES DESCRIBED BY LE COUTEUR IN THE FRAMEWORK OF STA-    8888 1451
         TISTICAL MODEL ARE USED.  THE ENERGY DISTRIBUTION OF      8888 1451
         FISSION NEUTRONS WAS EVALUATED BY TERREL'S FORMULA.       8888 1451
                                                                   8888 1451
*****                          REFERENCES                         8888 1451
                                                                   8888 1451
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   13-E.M.PENINGTON ET AL.,ANL-7306(1967)                          8888 1451
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                                    1          451          134                 8888 1451
                                    1          452            7                 8888 1451
                                    1          457           34                 8888 1451
                                    2          151           55                 8888 1451
                                    3            1           10                 8888 1451
                                    3            2           10                 8888 1451
                                    3            4           15                 8888 1451
                                    3           16            9                 8888 1451
                                    3           17            6                 8888 1451
                                    3           18           17                 8888 1451
                                    3           51           15                 8888 1451
                                    3           52           14                 8888 1451
                                    3           53           13                 8888 1451
                                    3           54           13                 8888 1451
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                                    3           67           12                 8888 1451
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                                    3          102           20                 8888 1451
                                    4            2           60                 8888 1451
                                    4           16           10                 8888 1451
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                                    4           18           10                 8888 1451
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                                    4           65           10                 8888 1451
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                                    4           91           10                 8888 1451
                                    5           16            9                 8888 1451
                                    5           17            8                 8888 1451
                                    5           18           12                 8888 1451
                                    5           91           11                 8888 1451
                                                                                8888 1  0
9.12330+04 2.31038+02                            2                              8888 1452
                                                                   1          148888 1452
        14          2
1.00000+05 2.32660+00 5.00000+05 2.37380+00 1.00000+06 2.43270+008888 1452
3.00000+06 2.66870+00 6.00000+06 3.02270+00 7.00000+06 3.16120+008888 1452
9.00000+06 3.41150+00 1.10000+07 3.64580+00 1.20000+07 3.76000+008888 1452
1.30000+07 3.87310+00 1.40000+07 4.00780+00 1.50000+07 4.19020+008888 1452
1.85000+07 4.72190+00 2.00000+07 4.94000+00                              8888 1452
                                                                         8888 1  0
9.12330+04 2.31038+02          0            0           0            28888 1457
2.33280+06 8.64000+03          0            0           4            28888 1457
6.64000+04 4.20000+03 9.39540+06 0.00000+00                             8888 1457
9.12330+04 2.31038+02          0            0           6            18888 1457
1.00000+00 0.00000+00 5.72500+05 2.40000+03 1.00000+00 0.00000+008888 1457
1.00000+00 0.00000+00          0            0          36            58888 1457
1.00000+00 0.00000+00 0.00000+00 0.00000+00 0.00000+00 0.00000+008888 1457
1.56700+05 2.40000+03 2.27000+01 1.70000+00 0.00000+00 0.00000+008888 1457
1.74000+05 2.40000+03 1.47000+01 2.00000+00 0.00000+00 0.00000+008888 1457
2.32000+05 2.40000+03 2.70000+01 4.00000+00 0.00000+00 0.00000+008888 1457
2.60600+05 2.40000+03 3.10000+01 4.00000+00 0.00000+00 0.00000+008888 1457
5.72500+05 2.40000+03 5.00000+00 0.00000+00 0.00000+00 0.00000+008888 1457
0.00000+00 0.00000+00          0            0         126          208888 1457
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3.60000-02 2.00000-03 0.00000+00 0.00000+00 0.00000+00 0.00000+008888 1457
1.72600+04 0.00000+00 1.00000-01 0.00000+00 5.12000+02 0.00000+008888 1457
2.85400+04 5.00000+01 1.80000+00 2.00000-01 3.30000+02 1.50000+018888 1457
4.03500+04 1.00000+01 1.00000+00 2.00000-01 3.50000+02 1.90000+018888 1457
4.16500+04 2.00000+01 3.50000-01 1.00000-01 1.27000+00 0.00000+008888 1457
5.15000+04 5.00000+02 2.00000-02 0.00000+00 1.15000+02 0.00000+008888 1457
5.79000+04 0.00000+00 1.00000-01 0.00000+00 1.82000+02 0.00000+008888 1457
7.52800+04 1.00000+01 3.26000+01 2.00000+00 1.13000+01 0.00000+008888 1457
8.65900+04 1.00000+01 4.90000+01 6.00000+00 7.50000+00 0.00000+008888 1457
9.20000+04 5.00000+02 1.00000-01 0.00000+00 2.01000+01 0.00000+008888 1457
1.03860+05 2.00000+01 1.92000+01 2.00000+00 4.70000+00 3.00000-018888 1457
2.48500+05 5.00000+02 1.50000+00 6.00000-01 3.50000-01 0.00000+008888 1457
2.58200+05 2.00000+02 1.00000-01 4.00000-02 5.51000-02 0.00000+008888 1457
2.71480+05 8.00000+01 7.90000+00 8.00000-01 2.64000-01 0.00000+008888 1457
2.98500+05 0.00000+00 9.00000-01 0.00000+00 3.98000-02 0.00000+008888 1457
3.00120+05 3.00000+01 1.72000+02 8.00000+00 1.06400+00 0.00000+008888 1457
3.11980+05 3.00000+01 1.00000+03 0.00000+00 9.57000-01 0.00000+008888 1457
3.40500+05 4.00000+01 1.17000+02 1.20000+01 6.80000-01 8.00000-028888 1457
3.75450+05 4.00000+01 1.60000+01 3.00000+00 1.00000-01 0.00000+008888 1457
3.98620+05 8.00000+01 3.30000+01 4.00000+00 8.50000-02 0.00000+008888 1457
4.15760+05 4.00000+01 4.20000+01 4.00000+00 1.48000-01 8.00000-038888 1457
                                                                8888 1  0
                                                                8888 0  0
9.12330+ 4 2.31038+ 2                                 1          8888 2151
9.12330+ 4 1.00000+ 0                                 2          8888 2151
1.00000- 5 3.85000+ 1          1          1          0         08888 2151
1.50000+ 0 8.91840- 1                                 1         08888 2151
2.31038+ 2 0.00000+ 0                               240        408888 2151
-1.00000- 1 1.50000+ 0 5.00006- 2 6.12300- 7 5.00000- 2 0.00000+ 08888 2151
4.30000- 1 1.50000+ 0 5.00001- 1 7.93450- 7 5.00000- 1 0.00000+ 08888 2151
7.95000- 1 1.50000+ 0 5.00013- 2 1.32850- 6 5.00000- 2 0.00000+ 08888 2151
1.34100+ 0 1.50000+ 0 3.91308- 2 1.30856- 4 3.90000- 2 0.00000+ 08888 2151
1.64400+ 0 1.50000+ 0 4.13962- 2 3.96195- 4 4.10000- 2 0.00000+ 08888 2151
2.35600+ 0 1.50000+ 0 5.00108- 2 1.08000- 5 5.00000- 2 0.00000+ 08888 2151
2.83000+ 0 1.50000+ 0 4.61918- 2 1.91770- 4 4.60000- 2 0.00000+ 08888 2151
3.38600+ 0 1.50000+ 0 4.03772- 2 3.77220- 4 4.00000- 2 0.00000+ 08888 2151
4.28300+ 0 1.50000+ 0 4.81079- 2 1.07886- 4 4.80000- 2 0.00000+ 08888 2151
5.15200+ 0 1.50000+ 0 5.54880- 2 4.88010- 4 5.50000- 2 0.00000+ 08888 2151
7.18100+ 0 1.50000+ 0 6.01994- 2 1.99370- 4 6.00000- 2 0.00000+ 08888 2151
8.26000+ 0 1.50000+ 0 6.50627- 2 6.26500- 5 6.50000- 2 0.00000+ 08888 2151
8.97000+ 0 1.50000+ 0 7.02061- 2 2.06056- 4 7.00000- 2 0.00000+ 08888 2151
9.37000+ 0 1.50000+ 0 7.13958- 2 1.39580- 3 7.00000- 2 0.00000+ 08888 2151
1.03500+ 1 1.50000+ 0 5.01316- 2 1.31580- 4 5.00000- 2 0.00000+ 08888 2151
1.08900+ 1 1.50000+ 0 6.51917- 2 1.91730- 4 6.50000- 2 0.00000+ 08888 2151
1.15200+ 1 1.50000+ 0 5.00984- 2 9.84290- 5 5.00000- 2 0.00000+ 08888 2151
1.16600+ 1 1.50000+ 0 5.00159- 2 1.58780- 5 5.00000- 2 0.00000+ 08888 2151
1.19300+ 1 1.50000+ 0 5.00257- 2 2.56980- 5 5.00000- 2 0.00000+ 08888 2151
1.21500+ 1 1.50000+ 0 7.54287- 2 4.28740- 4 7.50000- 2 0.00000+ 08888 2151
1.29000+ 1 1.50000+ 0 6.01304- 2 1.30377- 4 6.00000- 2 0.00000+ 08888 2151
1.41400+ 1 1.50000+ 0 5.00280- 2 2.79770- 5 5.00000- 2 0.00000+ 08888 2151
1.44200+ 1 1.50000+ 0 7.04937- 2 4.93658- 4 7.00000- 2 0.00000+ 08888 2151
1.48000+ 1 1.50000+ 0 5.00716- 2 7.15550- 5 5.00000- 2 0.00000+ 08888 2151
1.59600+ 1 1.50000+ 0 7.11026- 2 1.10262- 3 7.00000- 2 0.00000+ 08888 2151
1.63500+ 1 1.50000+ 0 5.00560- 2 5.60090- 5 5.00000- 2 0.00000+ 08888 2151
1.67300+ 1 1.50000+ 0 5.00573- 2 5.72630- 5 5.00000- 2 0.00000+ 08888 2151
1.70000+ 1 1.50000+ 0 5.03418- 2 3.41805- 4 5.00000- 2 0.00000+ 08888 2151
1.84000+ 1 1.50000+ 0 5.00510- 2 5.10400- 5 5.00000- 2 0.00000+ 08888 2151
1.90000+ 1 1.50000+ 0 5.01452- 2 1.45150- 4 5.00000- 2 0.00000+ 08888 2151
2.09300+ 1 1.50000+ 0 5.59016- 2 5.90160- 3 5.00000- 2 0.00000+ 08888 2151
2.18500+ 1 1.50000+ 0 5.10891- 2 1.08913- 3 5.00000- 2 0.00000+ 08888 2151
2.28700+ 1 1.50000+ 0 5.25920- 2 2.59198- 3 5.00000- 2 0.00000+ 08888 2151
2.42300+ 1 1.50000+ 0 5.06202- 2 6.20220- 4 5.00000- 2 0.00000+ 08888 2151
2.69000+ 1 1.50000+ 0 5.05119- 2 5.11910- 4 5.00000- 2 0.00000+ 08888 2151
2.81800+ 1 1.50000+ 0 5.09608- 2 9.60835- 4 5.00000- 2 0.00000+ 08888 2151
3.10500+ 1 1.50000+ 0 5.22456- 2 2.24562- 3 5.00000- 2 0.00000+ 08888 2151
3.26500+ 1 1.50000+ 0 5.18513- 2 1.85134- 3 5.00000- 2 0.00000+ 08888 2151
3.44000+ 1 1.50000+ 0 5.08035- 2 8.03526- 4 5.00000- 2 0.00000+ 08888 2151
3.62000+ 1 1.50000+ 0 5.22803- 2 2.28031- 3 5.00000- 2 0.00000+ 08888 2151
3.85    + 1 1.       + 4          2          1          0         0 8888 2151
1.5     + 0 8.91840- 1            0          0          2         0 8888 2151
2.31038+ 2 0.0     + 0            0          0         12          28888 2151
1.83900+ 0 1.0     + 0 1.0     + 0 1.73320- 4 5.6     - 2 0.0     + 08888 2151
1.10400+ 0 2.0     + 0 1.0     + 0 1.04    - 4 5.5     - 2 0.0     + 08888 2151
2.31038+ 2 0.0     + 0            1          0         24          48888 2151
5.52000+ 0 0.0     + 0 1.0     + 0 1.10400- 3 5.5     - 2 0.0     + 08888 2151
1.83900+ 0 1.0     + 0 1.0     + 0 3.68000- 4 5.5     - 2 0.0     + 08888 2151
1.10400+ 0 2.0     + 0 1.0     + 0 2.20820- 4 5.5     - 2 0.0     + 08888 2151
0.78700+ 0 3.0     + 0 1.0     + 0 1.57700- 4 5.5     - 2 0.0     + 08888 2151
                                                                8888 2  0
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                                                                                8888 0  0
9.1233E+04 2.31038+02                        99                                 8888 3  1
0.0000E+00 0.0000E+00                                                1          218888 3  1
        21          2                                                            8888 3  1
1.00000- 5 0.00000+ 0 1.00000+ 4 0.00000+ 0 1.00000+ 4 1.69699+ 18888 3  1
5.00000+ 4 1.38418+ 1 1.00000+ 5 1.25633+ 1 5.00000+ 5 7.92949+ 08888 3  1
1.00000+ 6 6.62185+ 0 2.00000+ 6 7.52687+ 0 3.00000+ 6 8.08047+ 08888 3  1
4.00000+ 6 8.11925+ 0 5.00000+ 6 7.25670+ 0 6.00000+ 6 6.52590+ 08888 3  1
7.00000+ 6 6.07670+ 0 8.00000+ 6 6.00050+ 0 9.00000+ 6 5.94790+ 08888 3  1
1.00000+ 7 5.88060+ 0 1.20000+ 7 5.91080+ 0 1.40000+ 7 6.00000+ 08888 3  1
1.60000+ 7 6.10000+ 0 1.80000+ 7 6.20000+ 0 2.0000+ 7 6.30000+ 098888 3  1
                                                                                8888 3  0
9.1233E+04 2.31038+02                        99                                 8888 3  2
0.0000E+00 0.0000E+00                                                1          218888 3  2
        21          2                                                            8888 3  2
1.00000- 5 0.00000+ 0 1.00000+ 4 0.00000+ 0 1.00000+ 4 1.38360+ 18888 3  2
5.00000+ 4 1.20100+ 1 1.00000+ 5 1.03450+ 1 5.00000+ 5 5.60000+ 08888 3  2
1.00000+ 6 3.56000+ 0 2.00000+ 6 3.89000+ 0 3.00000+ 6 4.75100+ 08888 3  2
4.00000+ 6 4.85400+ 0 5.00000+ 6 4.33980+ 0 6.00000+ 6 3.77260+ 08888 3  2
7.00000+ 6 3.31470+ 0 8.00000+ 6 2.96920+ 0 9.00000+ 6 2.75490+ 08888 3  2
1.00000+ 7 2.66290+ 0 1.20000+ 7 2.71840+ 0 1.40000+ 7 3.06560+ 08888 3  2
1.60000+ 7 3.39860+ 0 1.80000+ 7 3.59660+ 0 2.00000+ 7 3.66345+ 08888 3  2
                                                                                8888 3  0
9.12330+ 4 2.31038+ 2          0            99          0                       08888 3  4
0.00000+ 0-6.68000+ 3          0             0          1                      358888 3  4
        35          2                                                            8888 3  4
7.00000+ 3 0.00000+ 0 1.00000+ 4 1.03900- 1 3.00000+ 4 1.22720- 18888 3  4
5.00000+ 4 1.56790- 1 6.00000+ 4 1.99760- 1 7.00000+ 4 2.47140- 18888 3  4
8.00000+ 4 3.90200- 1 9.00000+ 4 5.38240- 1 1.00000+ 5 1.08930+ 08888 3  4
2.00000+ 5 1.24600+ 0 3.00000+ 5 1.66610+ 0 4.00000+ 5 1.85000+ 08888 3  4
5.00000+ 5 2.04749+ 0 7.50000+ 5 2.53300+ 0 1.00000+ 6 2.37485+ 08888 3  4
1.50000+ 6 2.42561+ 0 2.00000+ 6 2.27687+ 0 3.00000+ 6 1.68697+ 08888 3  4
4.00000+ 6 1.54125+ 0 5.00000+ 6 1.38000+ 0 6.00000+ 6 1.36800+ 08888 3  4
7.00000+ 6 1.24400+ 0 8.00000+ 6 3.88400- 1 9.00000+ 6 7.17500- 18888 3  4
1.00000+ 7 6.40400- 1 1.10000+ 7 5.98100- 1 1.20000+ 7 5.67800- 18888 3  4
1.30000+ 7 3.85900- 1 1.40000+ 7 1.90000- 1 1.50000+ 7 1.03000- 18888 3  4
1.60000+ 7 7.00000- 2 1.70000+ 7 5.00000- 2 1.80000+ 7 3.50000- 28888 3  4
1.90000+ 7 2.50000- 2 2.00000+ 7 1.21500- 2                                    8888 3  4
                                                                                8888 3  0
9.12330+04 2.31038+02                        99                                 8888 3 16
0.00000+00-6.51700+06                                                2          188888 3 16
         2          3          18            5                                  8888 3 16
6.52000+06 0.00000+00 7.00000+06 5.42000-02 7.50000+06 3.05000-018888 3 16
8.00000+06 6.10000-01 8.50000+06 8.57000-01 9.00000+06 1.03000+008888 3 16
9.50000+06 1.14600+00 1.00000+07 1.21500+00 1.10000+07 1.24600+008888 3 16
1.20000+07 1.33000+00 1.30000+07 1.39400+00 1.40000+07 1.26300+008888 3 16
1.50000+07 9.24000-01 1.60000+07 5.92000-01 1.70000+07 3.53000-018888 3 16
1.80000+07 2.02000-01 1.90000+07 1.00000-01 2.00000+07 6.00000-028888 3 16
                                                                                8888 3  0
9.12330+04 2.31038+02                        99                                 8888 3 17
0.00000+00-1.20790+07                                                2           98888 3 17
         2          3           9            5                                  8888 3 17
1.21000+07 0.00000+00 1.30000+07 1.31000-01 1.40000+07 2.47000-018888 3 17
1.50000+07 3.33000-01 1.60000+07 4.53000-01 1.70000+07 5.01000-018888 3 17
1.80000+07 4.93000-01 1.90000+07 4.80000-01 2.00000+07 4.60000-018888 3 17
                                                                                8888 3  0
9.12330+04 2.31038+02                                                           8888 3 18
0.00000+00 0.17442+09                                                1          418888 3 18
        41          2                                                            8888 3 18
9.00000+04 0.00000+00 1.00000+05 1.00000-03 3.00000+05 1.00000-038888 3 18
5.00000+05 7.00000-03 7.00000+05 5.20000-02 9.00000+05 2.67000-018888 3 18
1.00000+06 5.19000-01 1.20000+06 8.59000-01 1.40000+06 1.03900+008888 3 18
1.60000+06 1.14900+00 1.80000+06 1.23000+00 2.00000+06 1.30100+008888 3 18
2.20000+06 1.36900+00 2.40000+06 1.43700+00 2.60000+06 1.50400+008888 3 18
2.80000+06 1.56500+00 3.00000+06 1.60800+00 3.20000+06 1.62700+008888 3 18
4.00000+06 1.69800+00 4.50000+06 1.65600+00 5.00000+06 1.51600+008888 3 18
5.50000+06 1.42200+00 6.00000+06 1.36800+00 6.50000+06 1.35100+008888 3 18
7.00000+06 1.44900+00 7.50000+06 1.52100+00 8.00000+06 1.52000+008888 3 18
8.50000+06 1.48300+00 9.00000+06 1.43400+00 9.50000+06 1.38600+008888 3 18
1.00000+07 1.35200+00 1.10000+07 1.34000+00 1.20000+07 1.28600+008888 3 18
1.30000+07 1.22700+00 1.40000+07 1.22700+00 1.50000+07 1.38400+008888 3 18
1.60000+07 1.58000+00 1.70000+07 1.74200+00 1.80000+07 1.86800+008888 3 18
1.90000+07 1.98400+00 2.00000+07 2.10000+00                                    8888 3 18
                                                                                8888 3  0
9.12330+ 4 2.31038+ 2          0             1          0                       08888 3 51
0.00000+ 0-6.68000+ 3          0             0          1                      358888 3 51
        35          2                                                            8888 3 51
7.00000+ 3 0.00000+ 0 1.00000+ 4 1.03900- 1 3.00000+ 4 1.22720- 18888 3 51
5.00000+ 4 1.56790- 1 6.00000+ 4 1.90860- 1 7.00000+ 4 2.11170- 18888 3 51
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2.00000+ 5 2.44080- 1 3.00000+ 5 2.32670- 1 4.00000+ 5 2.10630- 18888 3 51
5.00000+ 5 1.62095- 1 7.50000+ 5 1.13560- 1 1.00000+ 6 3.77640- 28888 3 51
1.50000+ 6 7.12940- 3 2.00000+ 6 1.59330- 3 3.00000+ 6 7.36820- 58888 3 51
4.00000+ 6 5.13530- 6 5.00000+ 6 5.58620- 7 6.00000+ 6 0.00000+ 03888 3 51
7.00000+ 6 0.00000+ 0 8.00000+ 6 0.00000+ 0 9.00000+ 6 0.00000+ 08888 3 51
1.00000+ 7 0.00000+ 0 1.10000+ 7 0.00000+ 0 1.20000+ 7 0.00000+ 08888 3 51
1.30000+ 7 0.00000+ 0 1.40000+ 7 0.00000+ 0 1.50000+ 7 0.00000+ 08888 3 51
1.60000+ 7 0.00000+ 0 1.70000+ 7 0.00000+ 0 1.80000+ 7 0.00000+ 08888 3 51
1.90000+ 7 0.00000+ 0 2.00000+ 7 0.00000+ 0                      8888 3 51
                                                                 8888 3  0
9.12330+ 4 2.31038+ 2           0           2           0          08888 3 52
0.00000+ 0-5.71500+ 4           0           0           1         328888 3 52
        32         2                                                8888 3 52
5.90000+ 4 0.00000+ 0 6.00000+ 4 8.90590- 3 7.00000+ 4 3.59720- 28888 3 52
8.00000+ 4 6.35850- 2 9.00000+ 4 7.79560- 2 1.00000+ 5 1.71650- 18888 3 52
2.00000+ 5 1.67960- 1 3.00000+ 5 1.85640- 1 4.00000+ 5 1.76020- 18888 3 52
5.00000+ 5 1.42610- 1 7.50000+ 5 1.09200- 1 1.00000+ 6 4.44590- 28888 3 52
1.50000+ 6 1.19660- 2 2.00000+ 6 3.02970- 3 3.00000+ 6 1.61730- 48888 3 52
4.00000+ 6 1.28800- 5 5.00000+ 6 1.47060- 6 6.00000+ 6 0.00000+ 08888 3 52
7.00000+ 6 0.00000+ 0 8.00000+ 6 0.00000+ 0 9.00000+ 6 0.00000+ 08888 3 52
1.00000+ 7 0.00000+ 0 1.10000+ 7 0.00000+ 0 1.20000+ 7 0.00000+ 08888 3 52
1.30000+ 7 0.00000+ 0 1.40000+ 7 0.00000+ 0 1.50000+ 7 0.00000+ 08888 3 52
1.60000+ 7 0.00000+ 0 1.70000+ 7 0.00000+ 0 1.80000+ 7 0.00000+ 08888 3 52
1.90000+ 7 0.00000+ 0 2.00000+ 7 0.00000+ 0                      8888 3 52
                                                                 8888 3  0
9.12330+ 4 2.31038+ 2           0           3           0          08888 3 53
0.00000+ 0-7.06000+ 4           0           0           1         308888 3 53
        30         2                                                8888 3 53
7.50000+ 4 0.00000+ 0 8.00000+ 4 9.24770- 2 9.00000+ 4 1.37790- 18888 3 53
1.00000+ 5 2.53950- 1 2.00000+ 5 2.64770- 1 3.00000+ 5 2.83820- 18888 3 53
4.00000+ 5 2.67710- 1 5.00000+ 5 2.12130- 1 7.50000+ 5 1.56550- 18888 3 53
1.00000+ 6 5.71090- 2 1.50000+ 6 1.31890- 2 2.00000+ 6 3.21180- 38888 3 53
3.00000+ 6 1.61830- 4 4.00000+ 6 1.20680- 5 5.00000+ 6 1.34200- 68888 3 53
6.00000+ 6 0.00000+ 0 7.00000+ 6 0.00000+ 0 8.00000+ 6 0.00000+ 08888 3 53
9.00000+ 6 0.00000+ 0 1.00000+ 7 0.00000+ 0 1.10000+ 7 0.00000+ 08888 3 53
1.20000+ 7 0.00000+ 0 1.30000+ 7 0.00000+ 0 1.40000+ 7 0.00000+ 08888 3 53
1.50000+ 7 0.00000+ 0 1.60000+ 7 0.00000+ 0 1.70000+ 7 0.00000+ 08888 3 53
1.80000+ 7 0.00000+ 0 1.90000+ 7 0.00000+ 0 2.00000+ 7 0.00000+ 08888 3 53
                                                                 8888 3  0
9.12330+ 4 2.31038+ 2           0           4           0          08888 3 54
0.00000+ 0-8.65000+ 4           0           0           1         298888 3 54
        29         2                                                8888 3 54
8.80000+ 4 0.00000+ 0 9.00000+ 4 7.30850- 2 1.00000+ 5 1.76520- 18888 3 54
2.00000+ 5 2.15650- 1 3.00000+ 5 1.97010- 1 4.00000+ 5 1.69370- 18888 3 54
5.00000+ 5 1.78860- 1 7.50000+ 5 8.33650- 2 1.00000+ 6 3.13530- 28888 3 54
1.50000+ 6 6.62760- 3 2.00000+ 6 1.56940- 3 3.00000+ 6 9.17350- 58888 3 54
4.00000+ 6 8.28240- 6 5.00000+ 6 1.10690- 6 6.00000+ 6 0.00000+ 08888 3 54
7.00000+ 6 0.00000+ 0 8.00000+ 6 0.00000+ 0 9.00000+ 6 0.00000+ 08888 3 54
1.00000+ 7 0.00000+ 0 1.10000+ 7 0.00000+ 0 1.20000+ 7 0.00000+ 08888 3 54
1.30000+ 7 0.00000+ 0 1.40000+ 7 0.00000+ 0 1.50000+ 7 0.00000+ 08888 3 54
1.60000+ 7 0.00000+ 0 1.70000+ 7 0.00000+ 0 1.80000+ 7 0.00000+ 08888 3 54
1.90000+ 7 0.00000+ 0 2.00000+ 7 0.00000+ 0                      8888 3 54
                                                                 8888 3  0
9.12330+ 4 2.31038+ 2           0           5           0          08888 3 55
0.00000+ 0-9.47000+ 4           0           0           1         288888 3 55
        28         2                                                8888 3 55
9.80000+ 4 0.00000+ 0 1.00000+ 5 7.15600- 2 2.00000+ 5 1.96770- 18888 3 55
3.00000+ 5 1.92270- 1 4.00000+ 5 1.65860- 1 5.00000+ 5 1.79180- 18888 3 55
7.50000+ 5 8.59100- 2 1.00000+ 6 3.14210- 2 1.50000+ 6 6.10310- 38888 3 55
2.00000+ 6 1.38490- 3 3.00000+ 6 7.60330- 5 4.00000+ 6 6.47790- 68888 3 55
5.00000+ 6 8.44050- 7 6.00000+ 6 0.00000+ 0 7.00000+ 6 0.00000+ 08888 3 55
8.00000+ 6 0.00000+ 0 9.00000+ 6 0.00000+ 0 1.00000+ 7 0.00000+ 08888 3 55
1.10000+ 7 0.00000+ 0 1.20000+ 7 0.00000+ 0 1.30000+ 7 0.00000+ 08888 3 55
1.40000+ 7 0.00000+ 0 1.50000+ 7 0.00000+ 0 1.60000+ 7 0.00000+ 08888 3 55
1.70000+ 7 0.00000+ 0 1.80000+ 7 0.00000+ 0 1.90000+ 7 0.00000+ 08888 3 55
2.00000+ 7 0.00000+ 0                                            8888 3 55
                                                                 8888 3  0
9.12330+ 4 2.31038+ 2           0           6           0          08888 3 56
0.00000+ 0-1.03600+ 5           0           0           1         278888 3 56
        27         2                                                8888 3 56
1.10000+ 5 0.00000+ 0 2.00000+ 5 9.49900- 2 3.00000+ 5 9.81310- 28888 3 56
4.00000+ 5 9.05650- 2 5.00000+ 5 1.03600- 1 7.50000+ 5 5.21880- 28888 3 56
1.00000+ 6 2.15920- 2 1.50000+ 6 5.35990- 3 2.00000+ 6 1.37150- 38888 3 56
3.00000+ 6 8.90950- 5 4.00000+ 6 8.77890- 6 5.00000+ 6 1.22140- 68888 3 56
6.00000+ 6 0.00000+ 0 7.00000+ 6 0.00000+ 0 8.00000+ 6 0.00000+ 08888 3 56
9.00000+ 6 0.00000+ 0 1.00000+ 7 0.00000+ 0 1.10000+ 7 0.00000+ 08888 3 56
1.20000+ 7 0.00000+ 0 1.30000+ 7 0.00000+ 0 1.40000+ 7 0.00000+ 08888 3 56
1.50000+ 7 0.00000+ 0 1.60000+ 7 0.00000+ 0 1.70000+ 7 0.00000+ 08888 3 56
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1.80000+ 7 0.00000+ 0 1.90000+ 7 0.00000+ 0 2.00000+ 7 0.00000+ 08888 3 56
                                                                   8888 3  0
9.12330+ 4 2.31038+ 2          0          7          0            08888 3 57
0.00000+ 0-1.09000+ 5          0          0          1           278888 3 57
        27          2                                                8888 3 57
1.20000+ 5 0.00000+ 0 2.00000+ 5 1.01860- 2 3.00000+ 5 2.18720- 28888 3 57
4.00000+ 5 2.84980- 2 5.00000+ 5 4.05390- 2 7.50000+ 5 2.48000- 28888 3 57
1.00000+ 6 1.21600- 2 1.50000+ 6 3.68540- 3 2.00000+ 6 1.01820- 38888 3 57
3.00000+ 6 7.54630- 5 4.00000+ 6 8.29610- 6 5.00000+ 6 1.21100- 68888 3 57
6.00000+ 6 0.00000+ 0 7.00000+ 6 0.00000+ 0 8.00000+ 6 0.00000+ 08888 3 57
9.00000+ 6 0.00000+ 0 1.00000+ 7 0.00000+ 0 1.10000+ 7 0.00000+ 08888 3 57
1.20000+ 7 0.00000+ 0 1.30000+ 7 0.00000+ 0 1.40000+ 7 0.00000+ 08888 3 57
1.50000+ 7 0.00000+ 0 1.60000+ 7 0.00000+ 0 1.70000+ 7 0.00000+ 08888 3 57
1.80000+ 7 0.00000+ 0 1.90000+ 7 0.00000+ 0 2.00000+ 7 0.00000+ 08888 3 57
                                                                   8888 3  0
9.12330+ 4 2.31038+ 2          0          8          0            08888 3 58
0.00000+ 0-1.63400+ 5          0          0          1           278888 3 58
        27          2                                                8888 3 58
1.70000+ 5 0.00000+ 0 2.00000+ 5 4.68540- 4 3.00000+ 5 3.36440- 38888 3 58
4.00000+ 5 7.59940- 3 5.00000+ 5 1.90660- 2 7.50000+ 5 1.62790- 28888 3 58
1.00000+ 6 1.12660- 2 1.50000+ 6 5.08490- 3 2.00000+ 6 1.55480- 38888 3 58
3.00000+ 6 1.04420- 4 4.00000+ 6 1.01490- 5 5.00000+ 6 1.25580- 68888 3 58
6.00000+ 6 0.00000+ 0 7.00000+ 6 0.00000+ 0 8.00000+ 6 0.00000+ 08888 3 58
9.00000+ 6 0.00000+ 0 1.00000+ 7 0.00000+ 0 1.10000+ 7 0.00000+ 08888 3 58
1.20000+ 7 0.00000+ 0 1.30000+ 7 0.00000+ 0 1.40000+ 7 0.00000+ 08888 3 58
1.50000+ 7 0.00000+ 0 1.60000+ 7 0.00000+ 0 1.70000+ 7 0.00000+ 08888 3 58
1.80000+ 7 0.00000+ 0 1.90000+ 7 0.00000+ 0 2.00000+ 7 0.00000+ 08888 3 58
                                                                   8888 3  0
9.12330+ 4 2.31038+ 2          0          9          0            08888 3 59
0.00000+ 0-1.69100+ 5          0          0          1           278888 3 59
        27          2                                                8888 3 59
1.80000+ 5 0.00000+ 0 2.00000+ 5 4.52640- 2 3.00000+ 5 8.71500- 28888 3 59
4.00000+ 5 9.01780-02 5.00000+ 5 1.01810- 1 7.50000+ 5 5.24410- 28888 3 59
1.00000+ 6 1.92070- 2 1.50000+ 6 3.58190- 3 2.00000+ 6 7.98720- 48888 3 59
3.00000+ 6 4.28220- 5 4.00000+ 6 3.52940- 6 5.00000+ 6 4.52870- 78888 3 59
6.00000+ 6 0.00000+ 0 7.00000+ 6 0.00000+ 0 8.00000+ 6 0.00000+ 08888 3 59
9.00000+ 6 0.00000+ 0 1.00000+ 7 0.00000+ 0 1.10000+ 7 0.00000+ 08888 3 59
1.20000+ 7 0.00000+ 0 1.30000+ 7 0.00000+ 0 1.40000+ 7 0.00000+ 08888 3 59
1.50000+ 7 0.00000+ 0 1.60000+ 7 0.00000+ 0 1.70000+ 7 0.00000+ 08888 3 59
1.80000+ 7 0.00000+ 0 1.90000+ 7 0.00000+ 0 2.00000+ 7 0.00000+ 08888 3 59
                                                                   8888 3  0
9.12330+ 4 2.31038+ 2          0         10          0            08888 3 60
0.00000+ 0-1.79200+ 5          0          0          1           278888 3 60
        27          2                                                8888 3 60
1.90000+ 5 0.00000+ 0 2.00000+ 5 5.90730- 3 3.00000+ 5 3.21620- 28888 3 60
4.00000+ 5 4.40810- 2 5.00000+ 5 7.86260- 2 7.50000+ 5 4.36510- 28888 3 60
1.00000+ 6 2.21380- 2 1.50000+ 6 7.91710- 3 2.00000+ 6 2.28440- 38888 3 60
3.00000+ 6 1.38230- 4 4.00000+ 6 1.20760- 5 5.00000+ 6 1.43180- 68888 3 60
6.00000+ 6 0.00000+ 0 7.00000+ 6 0.00000+ 0 8.00000+ 6 0.00000+ 08888 3 60
9.00000+ 6 0.00000+ 0 1.00000+ 7 0.00000+ 0 1.10000+ 7 0.00000+ 08888 3 60
1.20000+ 7 0.00000+ 0 1.30000+ 7 0.00000+ 0 1.40000+ 7 0.00000+ 08888 3 60
1.50000+ 7 0.00000+ 0 1.60000+ 7 0.00000+ 0 1.70000+ 7 0.00000+ 08888 3 60
1.80000+ 7 0.00000+ 0 1.90000+ 7 0.00000+ 0 2.00000+ 7 0.00000+ 08888 3 60
                                                                   8888 3  0
9.12330+ 4 2.31038+ 2          0         11          0            08888 3 61
0.00000+ 0-2.01700+ 5          0          0          1           268888 3 61
        26          2                                                8888 3 61
2.10000+ 5 0.00000+ 0 3.00000+ 5 1.02120- 1 4.00000+ 5 1.17000- 18888 3 61
5.00000+ 5 1.38500- 1 7.50000+ 5 7.47230- 2 1.00000+ 6 2.85030- 28888 3 61
1.50000+ 6 5.72360- 3 2.00000+ 6 1.33160- 3 3.00000+ 6 7.46560- 58888 3 61
4.00000+ 6 6.38270- 6 5.00000+ 6 8.35240- 7 6.00000+ 6 0.00000+ 08888 3 61
7.00000+ 6 0.00000+ 0 8.00000+ 6 0.00000+ 0 9.00000+ 6 0.00000+ 08888 3 61
1.00000+ 7 0.00000+ 0 1.10000+ 7 0.00000+ 0 1.20000+ 7 0.00000+ 08888 3 61
1.30000+ 7 0.00000+ 0 1.40000+ 7 0.00000+ 0 1.50000+ 7 0.00000+ 08888 3 61
1.60000+ 7 0.00000+ 0 1.70000+ 7 0.00000+ 0 1.80000+ 7 0.00000+ 08888 3 61
1.90000+ 7 0.00000+ 0 2.00000+ 7 0.00000+ 0                        8888 3 61
                                                                   8888 3  0
9.12330+ 4 2.31038+ 2          0         12          0            08888 3 62
0.00000+ 0-2.13300+ 5          0          0          1           268888 3 62
        26          2                                                8888 3 62
2.20000+ 5 0.00000+ 0 3.00000+ 5 9.50000- 2 4.00000+ 5 1.09450- 18888 3 62
5.00000+ 5 1.31740- 1 7.50000+ 5 7.00480- 2 1.00000+ 6 2.75890- 28888 3 62
1.50000+ 6 6.08690- 3 2.00000+ 6 1.49260- 3 3.00000+ 6 8.95680- 58888 3 62
4.00000+ 6 8.13170- 6 5.00000+ 6 1.09300- 6 6.00000+ 6 0.00000+ 08888 3 62
7.00000+ 6 0.00000+ 0 8.00000+ 6 0.00000+ 0 9.00000+ 6 0.00000+ 08888 3 62
1.00000+ 7 0.00000+ 0 1.10000+ 7 0.00000+ 0 1.20000+ 7 0.00000+ 08888 3 62
1.30000+ 7 0.00000+ 0 1.40000+ 7 0.00000+ 0 1.50000+ 7 0.00000+ 08888 3 62
1.60000+ 7 0.00000+ 0 1.70000+ 7 0.00000+ 0 1.80000+ 7 0.00000+ 08888 3 62
1.90000+ 7 0.00000+ 0 2.00000+ 7 0.00000+ 0                        8888 3 62
```

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                                                                                8888 3  0
9.12330+ 4 2.31038+ 2          0          13          0          08888 3 63
0.00000+ 0-2.37900+ 5          0           0          1         268888 3 63
        26         2                                                8888 3 63
2.40000+ 5 0.00000+ 0 3.00000+ 5 7.35780- 2 4.00000+ 5 9.69440- 28888 3 63
5.00000+ 5 1.21720- 1 7.50000+ 5 6.72560- 2 1.00000+ 6 2.68250- 28888 3 63
1.50000+ 6 5.97480- 3 2.00000+ 6 1.47610- 3 3.00000+ 6 8.91220- 58888 3 63
4.00000+ 6 8.10040- 6 5.00000+ 6 1.09020- 6 6.00000+ 6 0.00000+ 08888 3 63
7.00000+ 6 0.00000+ 0 8.00000+ 6 0.00000+ 0 9.00000+ 6 0.00000+ 08888 3 63
1.00000+ 7 0.00000+ 0 1.10000+ 7 0.00000+ 0 1.20000+ 7 0.00000+ 08888 3 63
1.30000+ 7 0.00000+ 0 1.40000+ 7 0.00000+ 0 1.50000+ 7 0.00000+ 08888 3 63
1.60000+ 7 0.00000+ 0 1.70000+ 7 0.00000+ 0 1.80000+ 7 0.00000+ 08888 3 63
1.90000+ 7 0.00000+ 0 2.00000+ 7 0.00000+ 0                      8888 3 63
                                                                 8888 3  0
9.12330+ 4 2.31038+ 2          0          14          0          08888 3 64
0.00000+ 0-2.57300+ 5          0           0          1         268888 3 64
        26         2                                                8888 3 64
2.60000+ 5 0.00000+ 0 3.00000+ 5 4.35480- 2 4.00000+ 5 1.09820- 18888 3 64
5.00000+ 5 2.15520- 1 7.50000+ 5 1.21280- 1 1.00000+ 6 4.65710- 28888 3 64
1.50000+ 6 1.12300- 2 2.00000+ 6 2.95500- 3 3.00000+ 6 1.58510- 48888 3 64
4.00000+ 6 1.19400- 5 5.00000+ 6 1.33620- 6 6.00000+ 6 0.00000+ 08888 3 64
7.00000+ 6 0.00000+ 0 8.00000+ 6 0.00000+ 0 9.00000+ 6 0.00000+ 08888 3 64
1.00000+ 7 0.00000+ 0 1.10000+ 7 0.00000+ 0 1.20000+ 7 0.00000+ 08888 3 64
1.30000+ 7 0.00000+ 0 1.40000+ 7 0.00000+ 0 1.50000+ 7 0.00000+ 08888 3 64
1.60000+ 7 0.00000+ 0 1.70000+ 7 0.00000+ 0 1.80000+ 7 0.00000+ 08888 3 64
1.90000+ 7 0.00000+ 0 2.00000+ 7 0.00000+ 0                      8888 3 64
                                                                 8888 3  0
9.12330+ 4 2.31038+ 2          0          15          0          08888 3 65
0.00000+ 0-2.79600+ 5          0           0          1         268888 3 65
        26         2                                                8888 3 65
2.90000+ 5 0.00000+ 0 3.00000+ 5 1.78030- 2 4.00000+ 5 3.97660- 28888 3 65
5.00000+ 5 5.94650- 2 7.50000+ 5 3.84780- 2 1.00000+ 6 1.72680- 28888 3 65
1.50000+ 6 4.63470- 3 2.00000+ 6 1.26240- 3 3.00000+ 6 8.56490- 58888 3 65
4.00000+ 6 8.52760- 6 5.00000+ 6 1.19800- 6 6.00000+ 6 0.00000+ 08888 3 65
7.00000+ 6 0.00000+ 0 8.00000+ 6 0.00000+ 0 9.00000+ 6 0.00000+ 08888 3 65
1.00000+ 7 0.00000+ 0 1.10000+ 7 0.00000+ 0 1.20000+ 7 0.00000+ 08888 3 65
1.30000+ 7 0.00000+ 0 1.40000+ 7 0.00000+ 0 1.50000+ 7 0.00000+ 08888 3 65
1.60000+ 7 0.00000+ 0 1.70000+ 7 0.00000+ 0 1.80000+ 7 0.00000+ 08888 3 65
1.90000+ 7 0.00000+ 0 2.00000+ 7 0.00000+ 0                      8888 3 65
                                                                 8888 3  0
9.12330+ 4 2.31038+ 2          0          16          0          08888 3 66
0.00000+ 0-3.00400+ 5          0           0          1         258888 3 66
        25         2                                                8888 3 66
3.10000+ 5 0.00000+ 0 4.00000+ 5 3.39500- 2 5.00000+ 5 5.42050- 28888 3 66
7.50000+ 5 3.68490- 2 1.00000+ 6 1.67780- 2 1.50000+ 6 4.54860- 38888 3 66
2.00000+ 6 1.24860- 3 3.00000+ 6 8.52360- 5 4.00000+ 6 8.49730- 68888 3 66
5.00000+ 6 1.20000- 6 6.00000+ 6 0.00000+ 0 7.00000+ 6 0.00000+ 08888 3 66
8.00000+ 6 0.00000+ 0 9.00000+ 6 0.00000+ 0 1.00000+ 7 0.00000+ 08888 3 66
1.10000+ 7 0.00000+ 0 1.20000+ 7 0.00000+ 0 1.30000+ 7 0.00000+ 08888 3 66
1.40000+ 7 0.00000+ 0 1.50000+ 7 0.00000+ 0 1.60000+ 7 0.00000+ 08888 3 66
1.70000+ 7 0.00000+ 0 1.80000+ 7 0.00000+ 0 1.90000+ 7 0.00000+ 08888 3 66
2.00000+ 7 0.00000+ 0                                            8888 3 66
                                                                 8888 3  0
9.12330+ 4 2.31038+ 2          0          17          0          08888 3 67
0.00000+ 0-3.66100+ 5          0           0          1         258888 3 67
        25         2                                                8888 3 67
3.70000+ 5 0.00000+ 0 4.00000+ 5 2.56810- 3 5.00000+ 5 1.14750- 28888 3 67
7.50000+ 5 1.37040- 2 1.00000+ 6 8.05200- 3 1.50000+ 6 2.86430- 38888 3 67
2.00000+ 6 8.85510- 4 3.00000+ 6 7.06020- 5 4.00000+ 6 7.90860- 68888 3 67
5.00000+ 6 1.09000- 6 6.00000+ 6 0.00000+ 0 7.00000+ 6 0.00000+ 08888 3 67
8.00000+ 6 0.00000+ 0 9.00000+ 6 0.00000+ 0 1.00000+ 7 0.00000+ 08888 3 67
1.10000+ 7 0.00000+ 0 1.20000+ 7 0.00000+ 0 1.30000+ 7 0.00000+ 08888 3 67
1.40000+ 7 0.00000+ 0 1.50000+ 7 0.00000+ 0 1.60000+ 7 0.00000+ 08888 3 67
1.70000+ 7 0.00000+ 0 1.80000+ 7 0.00000+ 0 1.90000+ 7 0.00000+ 08888 3 67
2.00000+ 7 0.00000+ 0                                            8888 3 67
                                                                 8888 3  0
9.12330+ 4 2.31038+ 2          0          99          0          08888 3 91
0.00000+ 0-3.66100+ 5          0           0          1         258888 3 91
        25         2                                                8888 3 91
3.70000+ 5 0.00000+ 0 4.00000+ 5 8.60000- 2 5.00000+ 5 9.63470- 28888 3 91
7.50000+ 5 1.37270+ 0 1.00000+ 6 1.91480+ 0 1.50000+ 6 2.31390+ 08888 3 91
2.00000+ 6 2.24840+ 0 3.00000+ 6 1.68530+ 0 4.00000+ 6 1.54110+ 08888 3 91
5.00000+ 6 1.37998+ 0 6.00000+ 6 1.36800+ 0 7.00000+ 6 1.24400+ 08888 3 91
8.00000+ 6 8.88400- 1 9.00000+ 6 7.17500- 1 1.00000+ 7 6.40400- 18888 3 91
1.10000+ 7 5.98100- 1 1.20000+ 7 5.67800- 1 1.30000+ 7 3.85900- 18888 3 91
1.40000+ 7 1.90000- 1 1.50000+ 7 1.03000- 1 1.60000+ 7 7.00000- 28888 3 91
1.70000+ 7 5.00000- 2 1.80000+ 7 3.50000- 2 1.90000+ 7 2.50000- 28888 3 91
2.00000+ 7 1.21500- 2                                            8888 3 91
                                                                 8888 3  0
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 9.12330+04 2.31038+02                      99                          8888 3102
 0.00000+00 0.51970+07                                   1            508888 3102
         50          3                                                   8888 3102
 1.00000-05 0.00000+00 1.00000+04 0.00000+00 1.00000+04 3.03000+008888 3102
 2.00000+04 2.27400+00 3.00000+04 1.97700+00 4.00000+04 1.80000+008888 3102
 5.00000+04 1.67500+00 6.00000+04 1.57500+00 7.00000+04 1.48600+008888 3102
 8.00000+04 1.37100+00 9.00000+04 1.25000+00 1.00000+05 1.12900+008888 3102
 3.00000+05 4.07000-01 5.00000+05 2.75000-01 7.00000+05 2.34000-018888 3102
 9.00000+05 1.92000-01 1.00000+06 1.68000-01 1.20000+06 1.33000-018888 3102
 1.40000+06 1.06000-01 1.60000+06 8.60000-02 1.80000+06 7.10000-028888 3102
 2.0000E+06 5.9000E-02 2.2000E+06 4.7000E-02 2.4000E+06 4.3500E-028888 3102
 2.6000E+06 4.0000E-02 2.8000E+06 3.7000E-02 3.0000E+06 3.4500E-028888 3102
 4.00000+06 2.60000-02 4.50000+06 2.30000-02 5.00000+06 2.09000-028888 3102
 5.50000+06 1.88000-02 6.00000+06 1.73000-02 6.50000+06 1.60000-028888 3102
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 1.00000+07 1.03000-02 1.10000+07 9.40000-03 1.20000+07 8.60000-038888 3102
 1.30000+07 8.00000-03 1.40000+07 7.40000-03 1.50000+07 6.90000-038888 3102
 1.60000+07 6.40000-03 1.70000+07 5.90000-03 1.80000+07 5.40000-038888 3102
 1.90000+07 4.90000-03 2.00000+07 4.40000-03                          8888 3102
                                                                      8888 3   0
                                                                      8888 0   0
 9.12330+04 2.31038+02          1           1           0           08888 4   2
 0.00000+00 2.31038+02          0           2         400          198888 4   2
 1.00000+00 2.88552-03 3.90625-06 9.50572-10 1.23135-10 2.13360-128888 4   2
 1.98161-14 1.41084-16 1.32067-18 2.38064-20 0.00000+ 0 0.00000+ 08888 4   2
 0.00000+ 0 0.00000+ 0 0.00000+ 0 0.00000+ 0 0.00000+ 0 0.00000+ 08888 4   2
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-1.00000+ 0 5.00000- 1 1.00000+ 0 5.00000- 1                              8888 4 61
                                                                          8888 4  0
 9.12330+ 4 2.31038+ 2            0            2            0            08888 4 62
 0.00000+ 0 2.31038+ 2            0            2            0            08888 4 62
 0.00000+ 0 0.00000+ 0            0            0            1            28888 4 62
          2                 2                                             8888 4 62
```

```
 0.00000+ 0 1.00000- 3            0            0            1            28888 4 62
        2           2                                                      8888 4 62
-1.00000+ 0 5.00000- 1 1.00000+ 0 5.00000- 1                               8888 4 62
 0.00000+ 0 2.00000+ 7            0            0            1            28888 4 62
        2           2                                                      8888 4 62
-1.00000+ 0 5.00000- 1 1.00000+ 0 5.00000- 1                               8888 4 62
                                                                           8888 4  0
 9.12330+ 4 2.31038+ 2            0            2            0            08888 4 63
 0.00000+ 0 2.31038+ 2            0            2            0            08888 4 63
 0.00000+ 0 0.00000+ 0            0            0            1            28888 4 63
        2           2                                                      8888 4 63
 0.00000+ 0 1.00000- 3            0            0            1            28888 4 63
        2           2                                                      8888 4 63
-1.00000+ 0 5.00000- 1 1.00000+ 0 5.00000- 1                               8888 4 63
 0.00000+ 0 2.00000+ 7            0            0            1            28888 4 63
        2           2                                                      8888 4 63
-1.00000+ 0 5.00000- 1 1.00000+ 0 5.00000- 1                               8888 4 63
                                                                           8888 4  0
 9.12330+ 4 2.31038+ 2            0            2            0            08888 4 64
 0.00000+ 0 2.31038+ 2            0            2            0            08888 4 64
 0.00000+ 0 0.00000+ 0            0            0            1            28888 4 64
        2           2                                                      8888 4 64
 0.00000+ 0 1.00000- 3            0            0            1            28888 4 64
        2           2                                                      8888 4 64
-1.00000+ 0 5.00000- 1 1.00000+ 0 5.00000- 1                               8888 4 64
 0.00000+ 0 2.00000+ 7            0            0            1            28888 4 64
        2           2                                                      8888 4 64
-1.00000+ 0 5.00000- 1 1.00000+ 0 5.00000- 1                               8888 4 64
                                                                           8888 4  0
 9.12330+ 4 2.31038+ 2            0            2            0            08888 4 65
 0.00000+ 0 2.31038+ 2            0            2            0            08888 4 65
 0.00000+ 0 0.00000+ 0            0            0            1            28888 4 65
        2           2                                                      8888 4 65
 0.00000+ 0 1.00000- 3            0            0            1            28888 4 65
        2           2                                                      8888 4 65
-1.00000+ 0 5.00000- 1 1.00000+ 0 5.00000- 1                               8888 4 65
 0.00000+ 0 2.00000+ 7            0            0            1            28888 4 65
        2           2                                                      8888 4 65
-1.00000+ 0 5.00000- 1 1.00000+ 0 5.00000- 1                               8888 4 65
                                                                           8888 4  0
 9.12330+ 4 2.31038+ 2            0            2            0            08888 4 66
 0.00000+ 0 2.31038+ 2            0            2            0            08888 4 66
 0.00000+ 0 0.00000+ 0            0            0            1            28888 4 66
        2           2                                                      8888 4 66
 0.00000+ 0 1.00000- 3            0            0            1            28888 4 66
        2           2                                                      8888 4 66
-1.00000+ 0 5.00000- 1 1.00000+ 0 5.00000- 1                               8888 4 66
 0.00000+ 0 2.00000+ 7            0            0            1            28888 4 66
        2           2                                                      8888 4 66
-1.00000+ 0 5.00000- 1 1.00000+ 0 5.00000- 1                               8888 4 66
                                                                           8888 4  0
 9.12330+ 4 2.31038+ 2            0            2            0            08888 4 67
 0.00000+ 0 2.31038+ 2            0            2            0            08888 4 67
 0.00000+ 0 0.00000+ 0            0            0            1            28888 4 67
        2           2                                                      8888 4 67
 0.00000+ 0 1.00000- 3            0            0            1            28888 4 67
        2           2                                                      8888 4 67
-1.00000+ 0 5.00000- 1 1.00000+ 0 5.00000- 1                               8888 4 67
 0.00000+ 0 2.00000+ 7            0            0            1            28888 4 67
        2           2                                                      8888 4 67
-1.00000+ 0 5.00000- 1 1.00000+ 0 5.00000- 1                               8888 4 67
                                                                           8888 4  0
 9.12330+ 4 2.31038+ 2            0            2            0            08888 4 91
 0.00000+ 0 2.31038+ 2            0            1            0            08888 4 91
 0.00000+ 0 0.00000+ 0            0            0            1            28888 4 91
        2           2                                                      8888 4 91
 0.00000+ 0 1.00000- 5            0            0            1            28888 4 91
        2           2                                                      8888 4 91
-1.00000+ 0 5.00000- 1 1.00000+ 0 5.00000- 1                               8888 4 91
 0.00000+ 0 2.00000+ 7            0            0            1            28888 4 91
        2           2                                                      8888 4 91
-1.00000+ 0 5.00000- 1 1.00000+ 0 5.00000- 1                               8888 4 91
                                                                           8888 4  0
                                                                           8888 0  0
 9.12330+04 2.31038+02            0            0            1            08888 5 16
 6.57467+06 0.00000+00            0            7            1            28888 5 16
        2           2                                                      8888 5 16
 6.57467+06 1.00000+00 2.00000+07 1.00000+00                               8888 5 16
 0.00000+00 0.00000+00            0            0            1            88888 5 16
```

```
           8           5                                                    8888 5 16
6.57467+06 5.52000+05 8.00000+06 5.97000+05 1.00000+07 6.54000+058888 5 16
1.20000+07 7.07000+05 1.40000+07 7.55000+05 1.60000+07 7.96000+058888 5 16
1.80000+07 8.43000+05 2.00000+07 8.84000+05                         8888 5 16
                                                                    8888 5  0
9.12330+04 2.31038+02          0           0           1           08888 5 17
1.22371+07 0.00000+00          0           7           1           28888 5 17
           2           2                                                    8888 5 17
1.22371+07 1.00000+00 2.00000+07 1.00000+00                         8888 5 17
0.00000+00 0.00000+00          0           0           1           58888 5 17
           5           5                                                    8888 5 17
1.22371+07 7.13000+05 1.40000+07 7.55000+05 1.60000+07 7.96000+058888 5 17
1.80000+07 8.43000+05 2.00000+07 8.84000+05                         8888 5 17
                                                                    8888 5  0
9.12330+04 2.31038+02          0           0           1           08888 5 18
-3.00000+07 0.00000+00         0           7           1           28888 5 18
           2           2                                                    8888 5 18
1.00000-03 1.00000+00 2.00000+07 1.00000+00                         8888 5 18
0.00000+00 0.00000+00          0           0           1          168888 5 18
          16           2                                                    8888 5 18
1.00000-03 1.28290+06 5.00000+05 1.28580+06 1.00000+06 1.29670+068888 5 18
3.00000+06 1.32360+06 6.00000+06 1.36240+06 6.50000+06 1.36900+068888 5 18
7.00000+06 1.37700+06 8.00000+06 1.39120+06 9.00000+06 1.40320+068888 5 18
1.10000+07 1.42680+06 1.20000+07 1.43810+06 1.30000+07 1.44920+068888 5 18
1.40000+07 1.46230+06 1.50000+07 1.47960+06 1.85000+07 1.52860+068888 5 18
2.00000+07 1.54890+06                                               8888 5 18
                                                                    8888 5  0
9.12330+04 2.31038+02          0           0           1           08888 5 91
4.49638+05 0.00000+00          0           9           1           28888 5 91
           2           2                                                    8888 5 91
4.49638+05 1.00000+00 2.00000+07 1.00000+00                         8888 5 91
0.00000+00 0.00000+00          0           0           1          158888 5 91
          15           5                                                    8888 5 91
4.49638+05 2.85000+05 5.00000+05 2.89000+05 1.00000+06 3.30000+058888 5 91
2.00000+06 3.96000+05 3.00000+06 4.50000+05 4.00000+06 4.98000+058888 5 91
5.00000+06 5.41000+05 6.00000+06 5.81000+05 8.00000+06 6.51000+058888 5 91
1.00000+07 7.14000+05 1.20000+07 7.71000+05 1.40000+07 8.24000+058888 5 91
1.60000+07 8.68000+05 1.80000+07 9.20000+05 2.00000+07 9.64000+058888 5 91
                                                                    8888 5  0
                                                                    8888 0  0
                                                                       0 0  0
                                                                      -1 0  0
```