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EVALUATION OF FISSION PRODUCT  
NUCLEAR DATA FOR FAST REACTOR  
(NEUTRON CROSS SECTIONS FOR 28 NUCLIDES)

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Japanese Nuclear Data Committee

日本原子力研究所  
Japan Atomic Energy Research Institute

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Evaluation of Fission Product Nuclear Data

for Fast Reactor\*

- Neutron Cross Sections for 28 Nuclides -

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Results of neutron cross-section evaluation are presented for 28 fission product nuclides selected as those of the highest priority for burnup characteristics of the fast breeder reactor. The cross sections considered are total, elastic scattering, inelastic scattering and capture, in the energy range of 100 eV to 15 MeV.

Calculation of the cross sections was performed with the spherical optical model and the statistical theory. The optical potential parameters were determined so as to fit the calculated total cross sections to the experimental region of  $75 \leq A \leq 150$ . The potential parameters were further tested and verified through comparison between calculated and experimental values of the elastic scattering cross section, its angular distributions, inelastic scattering cross section and neutron strength function. Level schemes for 28 nuclides were newly collected and evaluated in this work. The initial input values of average radiation width  $\bar{\Gamma}$  and level spacing  $\bar{D}$  were taken from BNL-325 and Baba's compilation, respectively. The calculated capture cross sections were renormalized to the measured values, when available, by mainly adjusting the parameter  $\bar{\Gamma}_\gamma/\bar{D}$ .

The capture cross sections obtained here were compared with those of Benzi et al. and of Cook. Large discrepancies were found among the evaluated data for nuclides whose experimental data did not exist. For the present evaluations of total, elastic scattering and inelastic scattering cross sections, the errors of the evaluated values were considered less than 30%, except in the low-energy resonance region.

Numerical data of the evaluated cross sections are stored in magnetic tape in accordance with the format of ENDF/B. They are also shown in tabular and graphical forms in the Appendix of this report.

\* This work was performed as one of the projects of the Japanese Nuclear Data Committee.

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高速炉に重要な核分裂生成物の核データの評価

2 8 核種の中性子断面積

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高速増殖炉の燃焼特性にとって最も影響が大きいと考えられる 28 種の核分裂生成物核種についてその中性子断面積を評価計算して求めた。求めた断面積は 100 eV から 15 MeV までの全断面積、弹性散乱断面積、非弹性散乱断面積および中性子捕獲断面積である。

断面積の計算は球型光学模型と統計模型を使って行った。光学模型ポテンシャルパラメータの決定は、質量数 75 ~ 150 の範囲で、全断面積の測定値が 30 % の誤差範囲で再現出来るように行った。更に弹性散乱断面積とその角分布、非弹性散乱断面積および中性子強度関数の測定値と計算値とを比較してポテンシャルパラメータの妥当性を調べた。核の準位パラメータは 28 核種について新に調べなおして決め、又、輻射巾の平均値  $\bar{\Gamma}_r$  やレベル間隔の平均値  $\bar{D}$  は B N L - 325 や馬場氏の編集物により調べた。中性子捕獲断面積は可能な限り  $\bar{\Gamma}_r / \bar{D}$  を調整して測定値に合わせるようにした。

この作業で求めた中性子捕獲断面積を Benz i 達や Cook の求めた値と比べたが、特に測定値のない核種の評価値同志の喰違いが大きかった。全断面積、弹性散乱、非弹性散乱断面積については、我々の評価値は、低エネルギー領域を除いて、30 % 以内の誤差範囲にあると考えて良い。

評価した断面積の値は ENDF/B フォーマットで磁気テープに格納してある。これらの数値は附録に表とグラフで示した。

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## 1. Introduction

The evaluation of fission product nuclear data is one of the important long-term subjects in the research and development program of fast reactor. In contrast to the situation in thermal reactor, the experimental data for neutron cross sections are quite meager in the energy region of interest to fast reactor. There have been several evaluation works in this field. The data in ABBN group cross section set<sup>(1)</sup> have been used widely in nuclear design calculation. There are more recent evaluations by Benzi et al.,<sup>(2,3,4)</sup> Cook,<sup>(5)</sup> and Schenter et al.<sup>(6)</sup> However, there exist large disagreements among the evaluated data of radiative capture cross section. In extreme cases the discrepancy amounts to a factor of 10 for the nuclide whose experimental data do not exist. The disagreement among the capture cross sections when all fission products are lumped is approximately 30%. This will cause the error of about 1%  $\Delta k/k$  in the prediction of reactivity effect of fission product for a typical burnup of fast reactor. There are less evaluated data of total, elastic scattering, and inelastic scattering cross sections.<sup>(3,5)</sup> Although the effects of these cross sections on neutronic properties of reactor are minor compared with that of the capture cross section, they are by no means negligible. Much more efforts are clearly needed to evaluate these cross sections.

In 1970, Japanese Nuclear Data Committee organized Fission Product Nuclear Data Working Group and Fission Product Reactor Constants Working Group to provide a comprehensive set of cross sections of fission products specifically for use in fast reactor. The nuclear data working group was assigned to provide the basic cross section data, and the reactor constants working group to produce and evaluate the reactor constants. A basic assumption made was that the neutron capture during irradiation could be neglected in the decay process of fission products, and therefore the decay was governed only by beta decay. A preliminary study was made under this assumption to select the important nuclides according to the magnitude of the contribution to the macroscopic capture cross section of total fission products in the reactor of high burnup.

The present report describes the results of the evaluation of neutron cross sections of 28 nuclides selected as being most important. These nuclides are:

Sr-90, Zr-93, Mo-95, Mo-97, Tc-99, Ru-101, Ru-102, Ru-104, Ru-106, Rh-103, Pd-105, Pd-107, Ag-109, I-129, Xe-131, Cs-133, Cs-135, Cs-137, Ce-144, Nd-143, Nd-144, Nd-145, Pm-147, Sm-147, Sm-149, Sm-151, Eu-153, Eu-155.

The types of reactions considered are the total, elastic scattering and its angular distribution, inelastic scattering, and radiative capture for the energy range from 100 eV to 15 MeV. The target accuracy of data evaluation was set as  $\pm 20\%$  for capture cross section, and  $\pm 30\%$  for other main partial cross sections. A more stringent requirement should be set for the accuracy of capture cross section, but the above value of target accuracy is considered as realistic from the present status of experimental data.

Since the cross sections are not measured for most of the nuclides in fission product region, the present evaluation has put more emphasis on obtaining a comprehensive set of cross sections rather than obtaining specific values of cross sections of individual nuclides. The calculation of cross sections was performed by the spherical optical model and the statistical theory. The statistical fluctuation of neutron width was not taken into account. The statistical calculation was simply extrapolated down to 100 eV according to the requirement from the reactor constants working group. This requirement is based on the presumption that the statistical calculation will give reasonable expectation values of cross section even in resonance energy region for a lumped fission product. Anyway, the present method of the evaluation includes several points which should be improved in the future work. The present results should be regarded as the first step of our evaluation work.

In the followings, Section 2 gives the general description about the theoretical model of calculation and the method of evaluation of cross sections. Section 3 describes the determination of optical potential parameters and the results of the extensive tests of this potential through the comparison of calculation and experiment of cross sections for naturally occurring isotopes. Section 4 summarizes other data used for calculation. These are the data for the level schemes of nuclei, the data for the average radiation width  $\bar{F}_\gamma$  and average level spacing  $\bar{D}$  of low energy neutron resonances, and neutron binding energy data. The data for level schemes of 28 nuclides were newly collected and evaluated. The calculated capture cross sections were normalized to the measured cross sections, when available, by mainly adjusting the parameter  $\bar{F}_\gamma / \bar{D}$ . The calculated compound elastic scattering cross section was then modified so as to conserve the calculated total cross section, keeping the other cross section values fixed. Several remarks are made in Section 5 about the results of the present evaluation. A provisional scope of future work is also given.

The evaluated cross sections are stored on magnetic tape in ENDF/B formats. Appendix 1 gives the details of the data processing and the procedure for preparing the final tape. The evaluated cross sections are also given in tabular form in Appendix 2 and in graphical form in Appendix 3. Appendix 3 gives also the comparison of the present results of capture cross section with experimental values and with the evaluated data of Benzi et al. and Cook. The present results are generally closer to the data of Benzi et al. than to the data of Cook, but there still remain large disagreement among the evaluated data for nuclides for which no experimental data exists. The accuracy of the present results for total, elastic scattering, and inelastic scattering cross sections is considered as satisfactory for reactor application.

## 2. General Description

Fission product nuclides are in the region of atomic number  $Z = 32$  to 68. There are about 700 nuclides in this region and about 300 nuclides of them are considered to be important as fission product nuclides. However, almost all fission product nuclides are unstable, and measurements of their cross sections are only performed for some limited nuclides. Number of experimental data and their reliability are not enough for evaluating the cross-section values of the fission product nuclides. Therefore, values of the cross sections of the fission product nuclides must be estimated on the basis of systematic trends of nuclear parameters.

In this work, optical model of the nucleus and the Hauser-Feshbach's formula<sup>7,8)</sup> were used in order to obtain total cross section, elastic scattering cross section, inelastic scattering cross section and capture cross section in the range of neutron energy  $E_n = 100$  eV to 15 MeV. Trends of the parameters used in the formula were investigated by using experimental data in the nuclear mass region mentioned above. For example, the optical potential parameters were investigated by using the experimental data of the total cross section, and their reliability were confirmed by comparing the experimental data with the calculated values of the elastic and inelastic scattering cross sections. Details of these investigations will be presented in section 3.

Since the calculations of the cross sections must be performed for many nuclides, it is better to classify the nuclides in accordance with their effect to burnup of the fast reactors. The most effective nuclides for burnup must have large values of macroscopic capture cross section which is defined as microscopic capture cross section times concentration of the nuclides per fission. The concentration or number density of the fission product nuclides changes with time owing to beta-decay and neutron capture. Change of the concentration is mainly due to beta-decay in fast reactor, since the capture cross section multiplied by neutron flux in reactor core corresponds to the half-life of about 10 to 30 years on average. It is very long term compared with a period of exchanging nuclear fuel of the usual fast reactors, and the concentration change due to neutron capture is negligible. Therefore, the beta-decay plays a dominant role for the concentration change. The most effective nuclides for burnup must have long life-time against beta-decay and large macroscopic capture cross section. In this work, the nuclides with longer life-time than 10 days were selected, and the following 28 nuclides were adopted as the most important nuclides;

Sr-90,	Zr-93,	Mo-95,	Mo-97,	Tc-99,
Ru-101,	Ru-102,	Rh-103,	Ru-104,	Pd-105,
Ru-106,	Pd-107,	Ag-109,	I-129,	Xe-131,
Cs-133,	Cs-135,	Cs-137,	Nd-143,	Ce-144,
Nd-144,	Nd-145,	Pm-147,	Sm-147,	Sm-149,
Sm-151,	Eu-153,	Eu-155.		

These nuclides were estimated to provide about 80% of macroscopic capture cross section of all fission product nuclides. Therefore, they were treated here as the most important nuclides of the fission products and their cross-section values were evaluated by using the experimental data and calculated values.

As mentioned above, the experimental data are not enough for evaluations of the cross-section values. The capture cross section is not measured yet for seventeen of the above mentioned 28 nuclides. Even for the nuclides whose cross sections are measured, there are many cases where their cross-section values are measured at only few energy points. However, the energy range required in this evaluation work is from 100 eV to 15 MeV. For such a wide range of energy, existing experimental data of these nuclides are too scarce to estimate the cross section values. Therefore, calculations with the nuclear model were mainly performed to obtain the cross-section values. Systematic trends of some nuclear parameters were looked for so that overall fits of the calculated values to the experimental data were satisfactory in the mass number region and in the energy region considered here. In this work, target accuracy of the fitting was 20 to 30%, considering present status of the experimental data and requests from reactor physicist.

There is an annoying problem in the low energy region. Below several keV, resonance levels are widely separated and the statistical model calculation is not suitable for obtaining the cross-section values. The resonance structure should be taken into account for evaluating the cross-section values. However, the evaluation of the precise resonance structure is not possible for the present, because the resonance parameters are not known experimentally for most of the fission product nuclides. One method to estimate the unknown resonance parameters is to generate them by Monte Carlo method with fitting the calculated resonance integral to the experimental data. Assuming the mean resonance parameters, this method may be applied to the nuclides of which the experimental data are not measured yet. Cross-section curve thus obtained must join smoothly with the cross-section curve of the statistical model calculations, in the energy region

above resonance. In order to obtain the smooth conjunction between the two curves, the Monte Carlo calculation with many random samplings should be carried out and very long computer-time must be required. In the present work, therefore, the statistical model calculation was extrapolated by force down to 100 eV from the requirement<sup>9)</sup> of the reactor physicists. The cross sections thus obtained will represent the expectation values of the average cross section in the energy region above 100 eV.

Above few MeV, direct nuclear process may have to be taken into account in the calculation of the cross sections. In this work, however, any calculations were not performed concerning the direct process, because present status of the experimental data is not satisfactory in the high energy region to do detailed comparison of the calculated values with the experimental data. Besides, the direct nuclear cross section may be sensitive to microscopic nature of the target and residual nuclei. Unfortunately, present knowledge about the microscopic nature is not enough to calculate the cross sections of the fission product nuclides.

In this work, the neutron capture cross section was calculated by using the following Hauser-Feshbach formula<sup>7,8)</sup>.

$$\sigma_{n,r}(E_n) = \frac{\pi}{k_n^2} \sum_{J\pi} \frac{2J+1}{2(2I+1)} \sum_i \frac{\epsilon_{s_1}^J T_1(E_n) f(E_n, E_i)}{1 + \xi^J f(E_n, 0) \sum_{i'} \epsilon_{s_{i'}}^{J'} T_{i'}(E_n - E_i)} \quad (2.1)$$

where I is the spin of the target nucleus,  $E_n$  is the incident energy of the neutron,  $i$  is the angular momentum quantum number of the incident neutron,  $s$  is the channel spin quantum number in the entrance channel,  $T_1(E_n)$  is the transmission coefficient of the incident neutron and  $T_{i'}(E_n - E_i)$  is for emitted neutron with the angular momentum quantum number  $i'$  leaving the residual nucleus in its excited state with energy  $E_i$ . A factor  $\epsilon_{s_1}^J$  is given as follows for conservation of the angular momenta:

$$\epsilon_{s_1}^J = \begin{cases} 2, & \text{if both } s_1 = |I - 1/2| \text{ and } s_2 = I + 1/2 \\ 1, & \text{if } s_1 \text{ or } s_2, \text{ not both} \\ 0, & \text{if neither } s_1 \text{ nor } s_2 \end{cases} \quad \text{satisfy } J - 1 \leq s_i \leq J + 1 .$$

Quantities  $\xi^J$  and  $f(E_n, X)$  are given respectively as follows:

$$\xi^J = [2\pi \Gamma_r^J(B_n)/D^J(B_n)]^{-1} \quad (2.2)$$

and

$$f(E_n, X) = \int_X^{B_n + X} \epsilon_r^3 p_r(\epsilon_r) \rho_{e_0}(B_n + X - \epsilon_r) d\epsilon_r / \int_0^{B_n + E_n} \epsilon_r^3 p_r(\epsilon_r) \rho_{e_0}(B_n + E_n - \epsilon_r) d\epsilon_r , \quad (2.3)$$

where  $p_r(\epsilon_r)$  stands for the profile function<sup>10)</sup> of the photo-absorption cross section at the photon energy  $\epsilon_r$ . Eq.(2.2) means that the quantity  $1/\xi^J$  is given as a transmission coefficient of the gamma-ray from the compound nucleus at zero neutron energy. This is used as a normalization factor of the gamma-ray transmission coefficients for arbitrary energy. Quantities  $\Gamma_r^J(B_n)$  and  $D^J(B_n)$  at neutron separation energy  $B_n$  are observed for s-wave neutron.<sup>5,11,12,13,14)</sup> The resonance level spacing  $D^J$  is expressed by using an observed level spacing  $D_{obs}$  as follows:

$$D^J = [2(2I+1)/(2J+1)] D_{obs} \quad (2.4)$$

For the gamma-ray width  $\Gamma_r^J$ , it is assumed to be independent of the spin  $J$ . In fact, quantities about the gamma-ray in Eq.(2.1) are not dependent on the spin  $J$ , except  $\xi^J$ . This is due to the level density formula adopted here:

$$\rho_{eJ}(U) = (2J+1) \rho_{eo}(U), \quad (2.5)$$

where dependence of the level density on the spin is only expressed by a factor  $2J+1$ , not including spin cut-off factor. Then, the gamma-ray width  $\Gamma_r^J$  is independent of the spin  $J$ .<sup>10)</sup> The level density  $\rho_{eo}(U)$  is given as follows.<sup>15)</sup>

$$\left. \begin{aligned} \rho_{eo}(U) &= \frac{1}{C_o U^2} \exp \{ 2\sqrt{aU} \} && \text{for } U \geq U_o, \\ &= \frac{1}{C_o U_o^2} \exp \{ 2\sqrt{aU_o} - (U_o - U)/T \} && \text{for } U < U_o \end{aligned} \right\} \quad (2.6)$$

Nuclear temperature  $T$  is given at a joint energy  $U_o$ . (Gilbert and Cameron<sup>15)</sup> had given an energy of tangency point  $E_c$  as  $U_o + A$ ) as follows:

$$T = 1/\{\sqrt{a/U_o} - 2\} \quad (2.7)$$

Excitation energy  $U$  is given by considering the pairing energy  $A$ :

$$U = E_n + B_n - A - \epsilon_r \quad (2.8)$$

Level density parameter  $a$ , normalization factor  $C_o$ , joint energy  $U_o$  and pairing energy  $A$  were obtained in this work by adopting parameters given by Gilbert and Cameron<sup>15)</sup>.

Neutron transmission coefficient  $T_1(E_n)$  in Eq.(2.1) is given by using the optical potential. As mentioned earlier, the optical potential was determined so that the experimental total cross section was reproduced in the mass region of fission product nuclides. Potential form used in the work is given as follows:

$$\mathbf{V}(\mathbf{r}) = -(\mathbf{V}_0 + i\mathbf{W}_I)\mathbf{f}_1(\mathbf{r}) - i\mathbf{W}_s\mathbf{f}_2(\mathbf{r}) - \mathbf{V}_{so} \left( \frac{\hbar}{m_\pi c} \right)^2 \frac{1}{r} \left| \frac{d\mathbf{f}_1(\mathbf{r})}{d\mathbf{r}} \right| (\boldsymbol{\sigma} \cdot \hat{\mathbf{l}}), \quad (2.9)$$

where

$$\mathbf{f}_1(r) = 1 / \{ 1 + \exp [ (r - R_1) / a_0 ] \}, \quad (2.10)$$

and

$$\mathbf{f}_2(r) = 4 \exp [ (r - R_2) / b ] / \{ 1 + \exp [ (r - R_2) / b ] \}^2, \quad (2.11)$$

Nuclear radii  $R_1$  and  $R_2$  are

$$R_1 = r_o A^{1/3} + r_1, \quad (2.12)$$

and

$$R_2 = r_s A^{1/3} + r_2, \quad (2.13)$$

respectively.

In Eq.(2.9), spin-orbit force is included. Therefore, the neutron transmission coefficient with orbital angular momentum  $I$  has two components, and they are expressed as  $T_I^{(+)}(E_n)$  and  $T_I^{(-)}(E_n)$  respectively. In this work,  $T_I(E_n)$  in Eq.(2.1) was given by the following form with  $T_I^{(+)}(E_n)$  and  $T_I^{(-)}(E_n)$ :

$$T_I(E_n) = \{ (\ell + 1) T_I^{(+)}(E_n) + \ell T_I^{(-)}(E_n) \} / (2\ell + 1) \quad (2.14)$$

Values of the cross section with Eq.(2.14) will not be different largely from ones calculated with  $T_I^{(+)}(E_n)$  and  $T_I^{(-)}(E_n)$  directly.

The inelastic scattering cross section for excitation of the discrete levels was calculated by using the following formula<sup>7)</sup>:

$$\begin{aligned} \sigma_{in}(E_n I \pi) &= \sum_{E'_n I' \pi'} \sigma_{in}(E_n I \pi \rightarrow E'_n I' \pi') \\ &= \sum_{E'_n I' \pi' k_n^2} \frac{\pi}{E'_n I' \pi' k_n^2} \frac{2J+1}{2(2I+1)} \frac{1}{\sigma_{JI}} \sum_{j_1} \omega_H(\pi I) T_I^{j_1}(E_n I \pi) \\ &\quad \times \sum_{j'_1 \pi'} \omega_H(\pi' I' \pi') T_I^{j'_1}(E'_n I' \pi'), \end{aligned} \quad (2.15)$$

where

$$\sigma_{JI} = \sum_{E'' I'' \pi'' j''_1} \omega_H(\pi'' I'') T_I^{j''_1}(E'' I'' \pi'') \quad (2.16)$$

and  $\omega_H(\pi I)$  expresses a conservation rule of the parity. The transmission coefficient  $T_I^{j'_1}(E'_n I' \pi')$  stands for  $T_I^{j'_1}(E'_n)$  corresponding to the excited level with its excitation energy  $E_n - E'_n$ , spin  $I'$  and parity  $\pi'$ . Eq.(2.15) is used in the case of lower incident energy than an energy of turning-point  $E_x$ , above which levels of the nucleus are assumed to be overlapping. When the incident energy  $E_n$  is larger than  $E_x$ , Eq.(2.15)

is rewritten as follows:

$$\sigma_{in}(E_n I \pi) = \sigma_{in}^{(D)}(E_n I \pi) + \sigma_{in}^{(0)}(E_n I \pi) \quad (2.17)$$

where

$$\sigma_{in}^{(D)}(E_n I \pi) = \sum_{E'_n I' \pi'} \sigma_{in}(E_n I \pi \rightarrow E'_n I' \pi'), \quad (2.18)$$

and

$$\sigma_{in}^{(0)}(E_n I \pi) = \int_0^{E_n - E_x} dE'_n \sum_{I' \pi'} \rho_{TI'}(E_n - E'_n) \sigma_{in}(E_n I \pi \rightarrow E'_n I' \pi'), \quad (2.19)$$

Denominator  $\sigma_{JH}$  is also rewritten as,

$$\begin{aligned} \sigma_{JH} &= \sum_{E'' I'' \pi'' j''} \omega_H(\pi'' I'') T_{j''}^{i''}(E'' I'' \pi'') \\ &+ \int_0^{E_n - E_x} dE'' \sum_{I'' \pi'' j''} \omega_H(\pi'' I'') T_{j''}^{i''}(E'' I'' \pi'') \rho_{TI''}(E_n - E''), \end{aligned} \quad (2.20)$$

Level density for the target nucleus is assumed to be the following form:

$$\begin{aligned} \rho_{TI}(U) &= \frac{2I+1}{C_0 U^2} \exp \left\{ 2\sqrt{aU} - I(I+1)/2\sigma^2 \right\} \quad \text{for } U \geq U_0, \\ &= \frac{2I+1}{C_0 U_0^2} \exp \left\{ 2\sqrt{aU_0} - I(I+1)/2\sigma_0^2 - (U_0 - U)/T \right\} \quad \text{for } U < U_0, \end{aligned} \quad (2.21)$$

where

$$U = E_n - E'_n - A \quad (2.22)$$

and  $\sigma_0^2$  is  $\sigma^2$  at  $U=U_0$ .

The level density parameter  $a$ , normalization factor  $C_0$ , joint energy  $U_0$  and pairing energy  $A$  were obtained by using the parameters given by Gilbert and Cameron<sup>15)</sup>. However, spin cut-off factor  $\sigma^2$  is slightly different from the definition of Gilbert and Cameron. In this work, a rigid body approximation was used for the formula of  $\sigma^2$ . After numerical investigations, however, values of the level density are only slightly different from ones of the Gilbert and Cameron's.

The total cross section, elastic scattering cross section and inelastic scattering cross section were obtained by using a computer code ELIESE-3<sup>16)</sup>, while the neutron capture cross section was calculated with a code RACY.<sup>17)</sup> As is well known, the optical potential model provides the total cross section, cross section for compound nucleus formation and shape elastic scattering cross section. They are related as follows:

$$\sigma_{\text{tot}} = \sigma_c + \sigma_{e1,s} \quad (2.23)$$

The cross section for compound nucleus formation  $\sigma_c$  is composed of the inelastic scattering cross section and the compound elastic scattering cross section in the framework of ELIESE-3;

$$\sigma_c = \sigma_{in} + \sigma_{e1,c}. \quad (2.24)$$

In Eq.(2.24), the neutron capture cross section,  $\sigma_{n,\gamma}(E_n)$ , is not included. This means that the cross section for compound nucleus formation must be divided into three components by modifying the inelastic scattering cross section and the compound elastic scattering cross section. Modification of these two quantities is given as follows:

$$\sigma_{in}^{(M)} = (\sigma_c - \sigma_{n,\gamma}) \cdot \sigma_{in} / \sigma_c, \quad (2.25)$$

and

$$\sigma_{e1,c}^{(M)} = (\sigma_c - \sigma_{n,\gamma}) \cdot \sigma_{e1,c} / \sigma_c, \quad (2.26)$$

where (M) stands for "modification". By using these two equations, the cross section for compound nucleus formation is rewritten as

$$\sigma_c = \sigma_{in}^{(M)} + \sigma_{e1,c}^{(M)} + \sigma_{n,\gamma}. \quad (2.27)$$

Numerical values of the cross sections obtained here were arranged in the format of ENDF/B<sup>18)</sup> type and stored in the magnetic tape. Tables and graphs of them will be given in Appendices 2 and 3 of this report. Parameters used in order to estimate the cross-section values will be also given in tabular form or graph.

### 3. Optical Potential Parameters

As mentioned in the previous section, calculations of the cross sections must be performed for many fission product nuclides in the wide energy range. For these calculations, systematic trends of the parameters are very useful tools. In this work, the systematic trends of the optical potential parameters were investigated by means of comparing the calculated values of the total cross section with the experimental data. Further comparison was made between the calculated values and the experimental data of neutron strength function, elastic scattering cross section and inelastic scattering cross section, in order to confirm the reliability of the potential parameters. Experimental data used in this work were collected from NEUDADA<sup>19)</sup> and BNL-325 2nd edition<sup>11)</sup>. The experimental data of the total cross section were surveyed and the data for 35 natural elements were used up to 15 MeV, in order to see their dependence on the mass number and the energy. In Figs. 3-1 to 3-17, their averaged values are shown with circles.

There have been many studies<sup>20-26)</sup> on the systematic trends of the optical potential parameters. Availability of the potential parameters was tested for several sets in the mass region of the fission product nuclides in the first stage of this work, and simplified local potential of Engelbrecht and Fiedeldey<sup>25)</sup> was adopted tentatively. The potential has been founded on a local optical potential equivalent to the non-local potential which reproduces the experimental data of s-wave neutron strength function at zero energy and the cross sections in the wide energy range for many nuclei. A preliminary set of the optical potential parameters used in this work was slightly modified by changing the surface term of imaginary potential from Gaussian type to derivative Woods-Saxon type. Table 3-1 shows the preliminary potential parameter set.

The preliminary parameter set was found to reproduce the experimental data of the total cross section roughly, up to 15 MeV, in the mass region of the fission product nuclides. However, discrepancies of about 10 to 40% between the experimental data and the calculated values were observed for nuclei near  $A=95$  and 140, and for nuclei of  $A=147$  to 175, below 5 MeV. Such discrepancies are serious, because these nuclides have high percentage of fission yield ratio above 1%. In Figs. 3-1 to 3-17, calculated values of the total cross section are shown with the experimental data for several nuclei.

In order to obtain better fits of the calculated values of the total cross section to the experimental data, automatic parameter search was

carried out starting from the preliminary parameter set, for the following 17 typical elements,

As-75,	Sr-88,	Y-89,	Nb-93,	Tc-99,	Rh-103,
In-115,	I-127,	Cs-133,	La-139,	Pr-141,	Pm-147,
Tb-159,	Ho-165,	Tm-169,	Lu-175,	Ta-181.	

Experimental data compared with were for the natural elements. Parameters looked for were strength  $V_o$  of the real potential, strength  $W_s$ , width parameter  $b$  and radius  $R_2$  of the surface term of the imaginary potential.

When the parameters  $V_o$ ,  $W_s$  and  $b$  were looked for, keeping the other parameters fixed at the preliminary values, the parameter  $V_o$  scattered around its initial value, about 46 MeV, for lighter nuclei than Pm-147 and decreased by 1 or 2 MeV for heavier nuclei than Pm-147 (Pm-147 was treated as an element of heavier nuclie). Product of two parameters,  $W_s$  and  $b$ , increased its value for almost all nuclei. In the case of searching for the parameters  $W_s$ ,  $R_2$  and  $b$ , keeping the other parameters fixed at the preliminary values,  $R_2$  tended to increase for the nuclei heavier than Pm-147. Product of  $W_s$  and  $b$  increased its value for all nuclei except Pm-147, Tm-169 and Lu-175.

These best-fit parameters, however, did not reveal the smooth trends from nucleus to nucleus. In general, the quality of fits must be sacrificed partly in order to obtain the smooth trends of the parameters. Since the preliminary values of  $V_o$  and  $R_2$  were not so altered for the lighter nuclie than Pm-147, they were adopted without modifications for these nuclei, though they were not necessarily the best values. Parameters  $W_s$  and  $b$ , as well as  $V_o$  and  $R_2$  for the heavier nuclei, were investigated further.

Results of the investigations on  $W_s$  showed that the small values of  $W_s$  brought about better fits than the large values of  $W_s$ . In particular, the fits in the low energy region, below 5 MeV, were rather good for about 7 MeV of  $W_s$ . Since the data in the energy region below 5 MeV were important for the reactor calculations, such values for  $W_s$  seemed to be acceptable in this work. Therefore,  $W_s=7$  was chosen tentatively. Values of the s-wave neutron strength function for Y and Nb obtained with  $W_s=7$  and  $b=0.3$  were slightly smaller than the experimental data. This difficulty, however, was overrided by using  $b=0.35$ . The parameter set with  $W_s=7$  and  $b=0.35$ , keeping the other parameters fixed at the preliminary values, brought about better fits than the preliminary set, on the whole, for the lighter nuclei than Pm-147. Product of  $W_s$  and  $b$  was distinctly smaller than that of their preliminary values, and was contrary to the results of the automatic parameter search mentioned above. This might be due to a

sort of the periodicity on the chi-square values<sup>16)</sup>. In general, the parameter space has many points where the chi-square value is minimized. Therefore, it is expected that the preliminary set is situated near a minimum point and the new set is near another minimum point. Such a small value of  $W_s$  and a large value of  $b$  would be expected also for the heavier nuclei than Pm-147. For the heavier nuclei, values of  $W_s$  and  $b$  were determined after investigations of the parameters  $V_0$  and  $b$ .

As mentioned above, the value of  $V_0$  was 1 or 2 MeV smaller than the preliminary value and  $R_2$  increased for the heavier nuclei than Pm-147. In order to investigate correlation between  $V_0$  and  $R_2$ , the two parameters were varied simultaneously for the heavier nuclei, keeping the other parameters fixed at the preliminary values. As illustrated in Fig.5-1 of Ref. 27, following two formulas were obtained for  $R_2$ ,

$$R_2 = 1.16A^{1/3} + 1.3 \quad (3.1)$$

and

$$R_2 = 1.2A^{1/3} + 1.1 \quad (3.1')$$

Using one of the two equations (3.1) and (3.1'), trend of the parameter  $V_0$  was investigated for Pm-147, Tb-159, Ho-165, Tm-169, Lu-175 and Ta-181. Result showed that the trend of  $V_0$  corresponding to Eq.(3.1) was better than that for Eq.(3.1'). Systematic trend of the parameter  $V_0$  thus obtained was expressed as,

$$V_0 = 52.5 - 40(N-Z)/A - 0.25E. \quad (3.2)$$

Using Eqs.(3.1) and (3.2), the parameters  $W_s$  and  $b$  obtained for the lighter nuclei were used to calculate the total cross section for the heavier nuclei. As illustrated in Figs. 7-1 to 7-10 of Ref. 27 and in Figs. 3-3 to 3-17 of this report, results with combination of  $W_s=7.0$  and  $b=0.35$  were better than those obtained with the preliminary set for almost all fission product nuclides. Therefore, the values of the parameters  $W_s$  and  $b$  were determined as 7 MeV and 0.35 fm, respectively, in this work.

The optical potential parameters thus obtained were summarized as follows:

$$\begin{aligned} V_0 &= 46.0 - 0.25E \quad \text{for } A < 147, \\ &= 52.5 - 40(N-Z)/A - 0.25E \quad \text{for } A \geq 147, \\ W_I &= 0.125E - 0.0004E^2, \\ W_s &= 7.0, \\ V_{so} &= 7.0, \end{aligned}$$

$$\left. \begin{aligned} R_1 &= 1.16A^{1/3} + 0.6, \\ R_2 &= 1.16A^{1/3} + 1.1 \quad \text{for } A < 147, \\ &= 1.16A^{1/3} + 1.3 \quad \text{for } A \geq 147, \\ a_0 &= 0.62, \end{aligned} \right\} \quad (3.3)$$

and

$$b = 0.35.$$

In Figs. 3-1 to 3-17 of this report and in Figs. 7-1 to 7-10 of Ref. 27, the calculated total cross sections with Eq.(3.3) are compared with the experimental data as well as the values calculated by using the preliminary set of the potential parameters. The results with Eq.(3.3) are better than those with the preliminary parameter set in the energy region below 5 MeV, on the whole. For 5 to 10 MeV, present results are good. For 10 to 15 MeV, however, the results with the preliminary parameter set are slightly better than the present results. In the whole energy range considered here, the worst discrepancies between the present results and the experimental data are about 20% below 5 MeV.

Calculated values of the s-wave and p-wave neutron strength functions are compared with the experimental data<sup>28-40)</sup> in Figs. 3-18 and 3-19. Agreement between them is generally good, especially for the lighter nuclei. For the heavier nuclei, effect of the nuclear deformations should be taken into account for reproducing the experimental value. In the present work, this effect is not considered, because main purpose of this work is to obtain the overall trends of the potential parameters for the spherical optical model.

For the parameter  $W_S$ , smaller value than 7 MeV may be favourable in the energy region below 5 MeV. Above 10 MeV, however, the energy dependence of the parameter  $W_S$  seems to be slowly increasing one with the energy. That is, it may increase from a smaller value than 7 MeV in the energy region below 5 MeV, through about 7 MeV between 5 to 10 MeV, to about 12 MeV above 10 MeV. This energy variation of  $W_S$  may be square root of the neutron energy, which is reported by Hodgson<sup>41)</sup>.

Further investigations were performed in this work, in order to confirm the reliability of the systematic trends of the potential parameters, by comparing the calculated values of the elastic and inelastic scattering cross sections with the experimental data<sup>42-63)</sup>. In Figs. 3-20 to 3-28, the calculated values of the elastic scattering cross section are compared with the experimental data for some nuclei. Below 1.0 MeV, discrepancies between them are rather large for Ag, Nb, La and Pr. However, the potential parameters obtained here are considered to satisfy the required accuracy

of 30% for the elastic scattering cross section.

In Figs. 10-1 to 10-11 of Ref. 27 and Figs. 3-29 to 3-35 of this report, calculated values of the angular distributions of the elastic scattering cross section are shown with the experimental data<sup>53 77)</sup>. Some of them are only the shape elastic scattering cross section. Comparison between the calculated values and the experimental data shows that there remain some discrepancies between them for La and Pr in the low energy region. In the high energy region, agreement between them is excellent, especially for the lighter nuclei. Averaged cosine of the scattering angle was calculated for some nuclei and compared with the experimental data. Results of this comparison showed that the discrepancies between them were within 20%. Therefore, the potential parameters obtained here are reliable for estimation of the averaged cosine of the scattering angle.

For the inelastic scattering cross section, comparison was performed between the calculated values and the experimental data<sup>47 55)</sup> of the total inelastic scattering cross section rather than the excitation cross sections for each discrete level. Level scheme and level density parameters used in the calculation are given in Table 3-2 for some nuclie of which calculated values of the inelastic scattering cross section are shown in Figs. 3-36 through 3-41 with the experimental data. Calculations are performed by using the Hauser and Feshbach theory<sup>7)</sup> and Moldauer theory<sup>78 80)</sup>. For Pr-141, result with the Moldauer theory is better than that with the Hauser and Feshbach theory, but for I-127, result with the Hauser and Feshbach theory is excellent. For the other nuclei it is not possible to judge which results are better, partly due to scarcity of the experimental data. Therefore, it is appropriate to use the Hauser and Feshbach theory to calculate the inelastic scattering cross section of the fission product nuclides, for saving the computer time.

In this section, the optical potential parameters used in this evaluation work were found and their systematic trends were discussed on the basis of comparison between the calculated values and the experimental data of the total cross section. Besides, their reliability was also investigated for the neutron strength function, elastic scattering cross section and inelastic scattering cross section. As discussed above, several problems remain about applicability of the potential parameters for some nuclei. However, the potential parameters obtained here are considered to be satisfactory to obtain the cross sections of the fission product nuclides for fast reactor.

Table 3-1 Preliminary set of the optical potential parameters

Geometrical Parameters (fm)	Potential Strength (MeV)
$r_o = r_s = 1.16$	$V_o = 46 - 0.25E$
$r_1 = 0.6$	$W_I = 0.125E - 4 \times 10^{-4} E^2$
$r_2 = 1.1$	$W_s = 14 - 0.2E$
$a_o = 0.62$	$V_{so} = 7$
$b = 0.3$	

Table 3-2 Level scheme and level density parameters. Parameter  $E_x$  is an energy above which levels of the residual nucleus are assumed to be overlapping. Parameters  $a$ ,  $A$  and  $E_c$  are the level density parameter, the pairing energy and the energy of tangency point<sup>15)</sup>.

		Y-89	Nb-93	I-127	Ba-138	La-139	Pr-141
Level Parameters	1	0.0 (1/2-)	0.0 (9/2+)	0.0 (3/2+)	0.0 (0+)	0.0 (7/2+)	0.0 (5/2+)
	2	0.91 (9/2+)	0.028(1/2-)	0.0576(7/2+)	1.898( 4+)	0.1658(5/2+)	0.1454(7/2+)
	3	1.51 (3/2-)	0.742(7/2+)	0.2028(3/2+)	2.090( 6+)	0.570(3/2+)	1.117(11/2-)
	4	1.74 (5/2-)	0.808(3/2-)	0.3750(1/2+)	2.189( 2+)	0.800(3/2+)	1.127(3/2+)
	5	2.23 (5/2+)	0.809(5/2+)	0.417(5/2+)	2.218( 2+)	1.070(9/2+)	1.292(5/2+)
	6	2.53 (7/2+)	0.952(13/2+)	0.590(9/2+)	2.307( 4+)	1.206(3/2+)	1.298(1/2+)
	7	2.61 (9/2+)	0.980(9/2+)	0.629(5/2+)	2.445( 3+)	1.217(7/2+)	1.435(3/2+)
	8	2.86 (3/2-)	1.080(7/2+)	0.651(9/2+)	2.583( 1+)	1.255(5/2+)	1.451(3/2+)
	9	3.08 (5/2-)	1.295(7/2-)	0.717(11/2+)		1.257(1/2+)	
	10	3.20 (5/2-)	1.337(17/2+)	0.745(9/2+)		1.310(1/2+)	
	11	3.69 (3/2+)	1.465(5/2+)	0.995(3/2+)		1.383(9/2+)	
	12			1.095(5/2+)		1.420(5/2+)	
	13			1.120(1/2+)		1.439(11/2-)	
	14			1.236(11/2-)		1.475(7/2+)	
	15					1.538(5/2+)	
Level Density Parameters	$E_x$	3.85	1.492	1.27	2.6	1.559	1.456
	$a$	11.53	12.52	13.79	12.43	14.61	15.96
	$A$	1.47	1.03	-1.18	2.43	0.89	0.89
	$E_c$	2.53	3.97	1.18	3.57	4.11	4.11

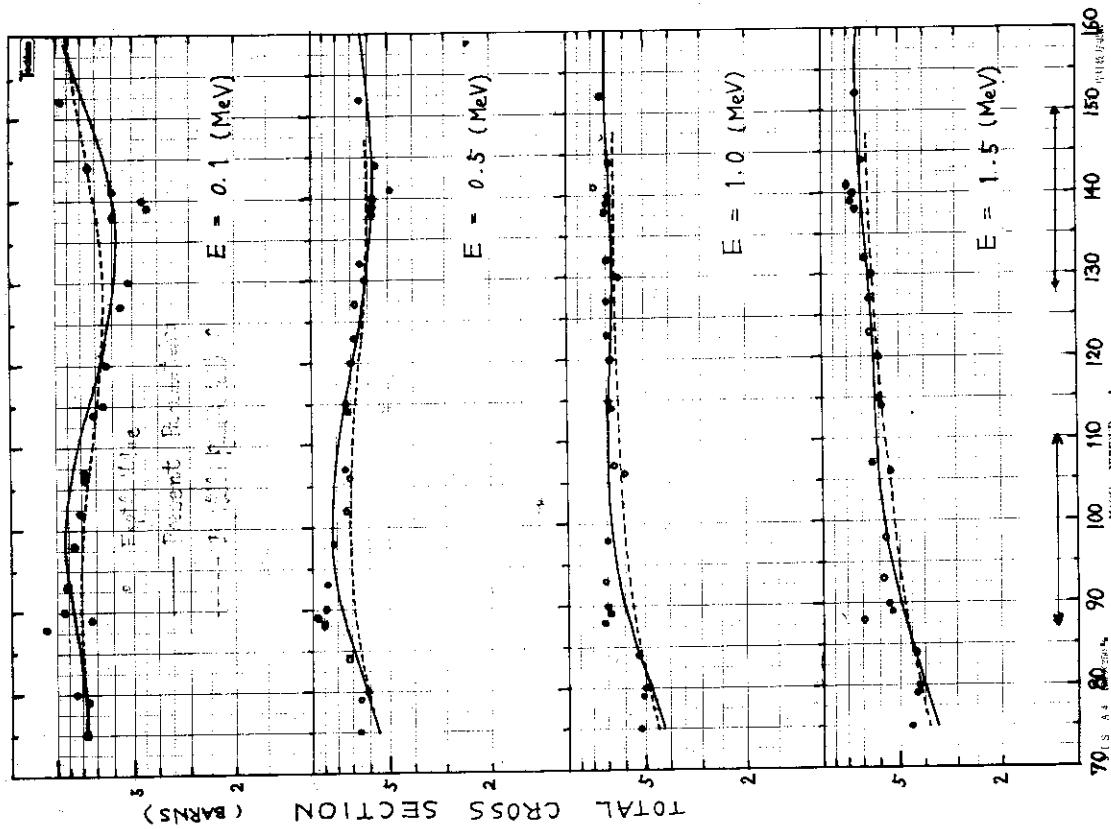


Fig. 3-1. Total cross sections for nuclei in the region of mass number,  
 $A=70$  to  $160$ , at energies  $0.1$ ,  $0.5$ ,  $1.0$  and  $1.5$  MeV, respectively.  
Open circles indicate experimental data. Broken and solid lines  
are cross section curves obtained with the preliminary potential  
parameters (Table 3-1) and the present potential parameters  
(Eq. (3.3)), respectively.

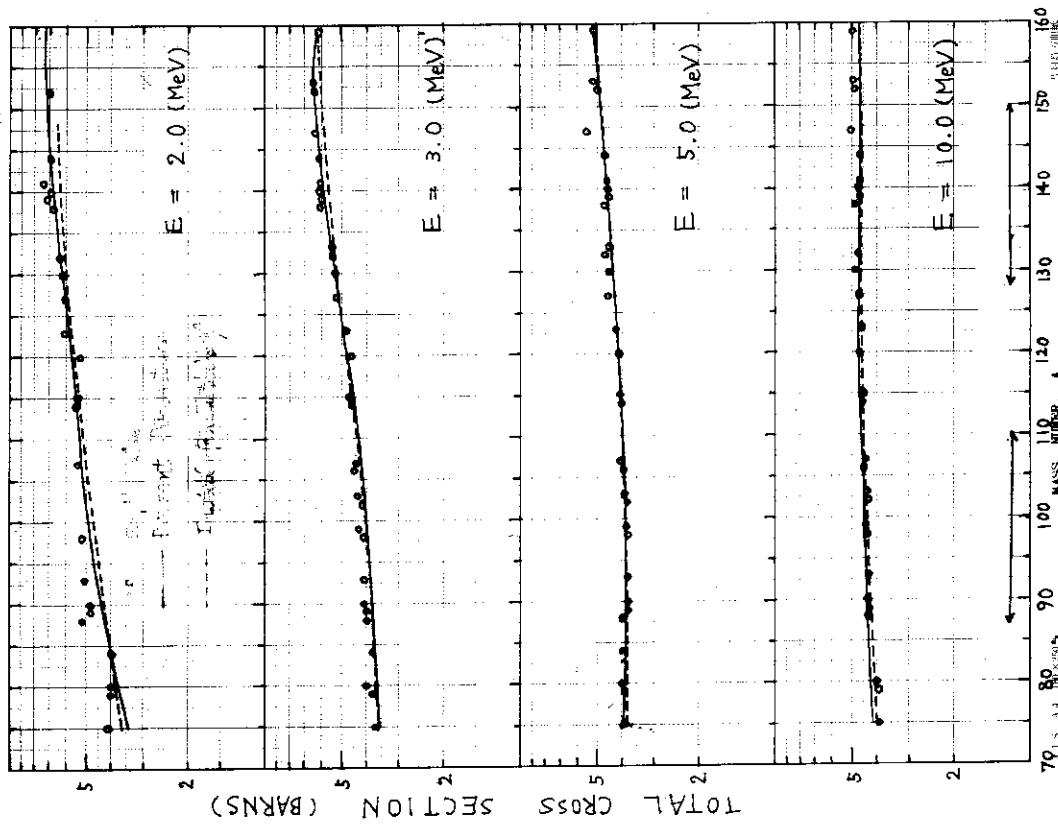


Fig. 3-2. Total cross sections for nuclei in the region of mass number,  
 $A=70$  to  $160$ , at energies  $2.0$ ,  $3.0$ ,  $5.0$  and  $10.0$  MeV, respectively.  
Open circles indicate experimental data. Broken and solid lines  
are cross section curves obtained with the preliminary potential  
parameters (Table 3-1) and the present potential parameters  
(Eq. (3.3)), respectively.

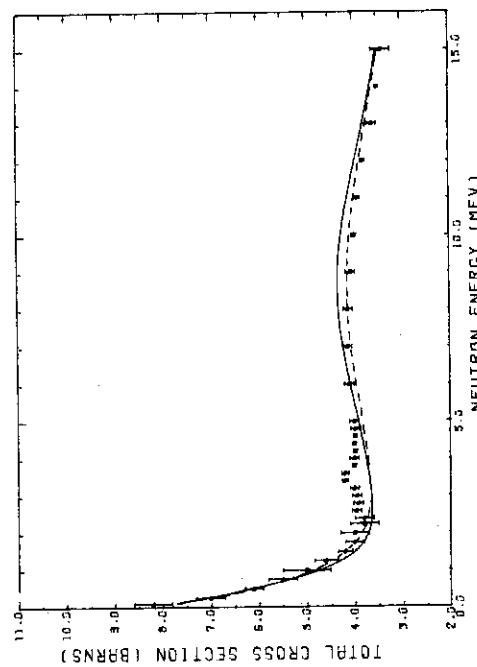


Fig. 3-3. Total cross section for Se. Calculations are performed for  $^{80}\text{Se}$ . Broken and solid lines are cross section curves obtained with the preliminary and present potential parameters, respectively.

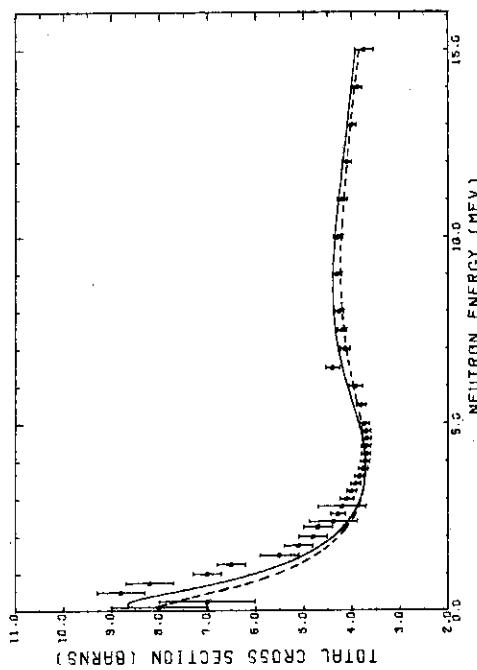


Fig. 3-4. Total cross section for Zr. Calculations are performed for  $^{90}\text{Zr}$ . Broken and solid lines are cross section curves obtained with the preliminary and present potential parameters, respectively.

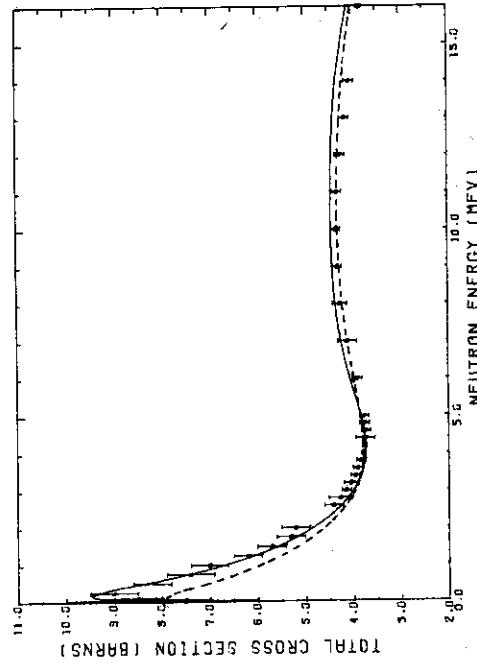


Fig. 3-5. Total cross section for Mo. Calculations are performed for  $^{98}\text{Mo}$ . Broken and solid lines are cross section curves obtained with the preliminary and present potential parameters, respectively.

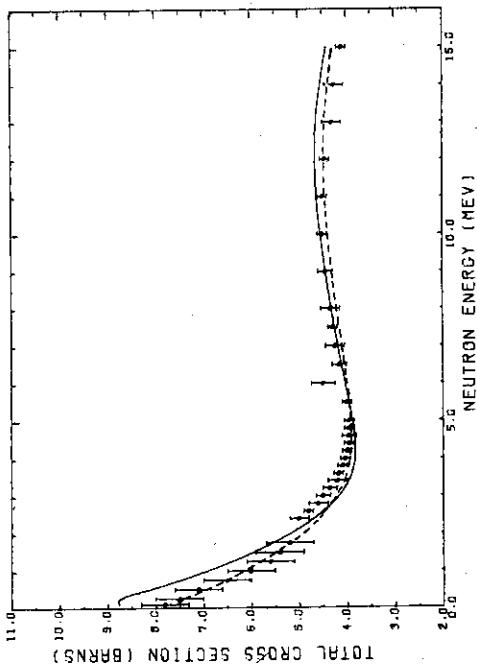


Fig. 3-6. Total cross section for Pd. Calculations are performed for  $^{106}\text{Pd}$ . Broken and solid lines are cross section curves obtained with the preliminary and present potential parameters, respectively.

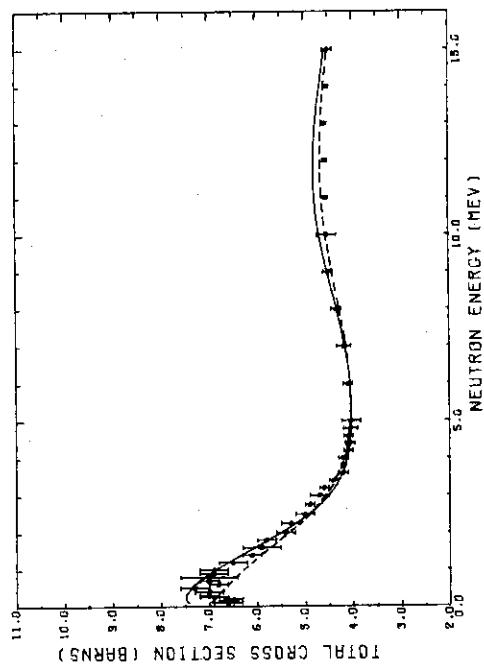


Fig. 3-7. Total cross section for  $^{115}\text{In}$ . Calculations are performed for  $^{115}\text{In}$ . Broken and solid lines are cross section curves obtained with the preliminary and present potential parameters, respectively.

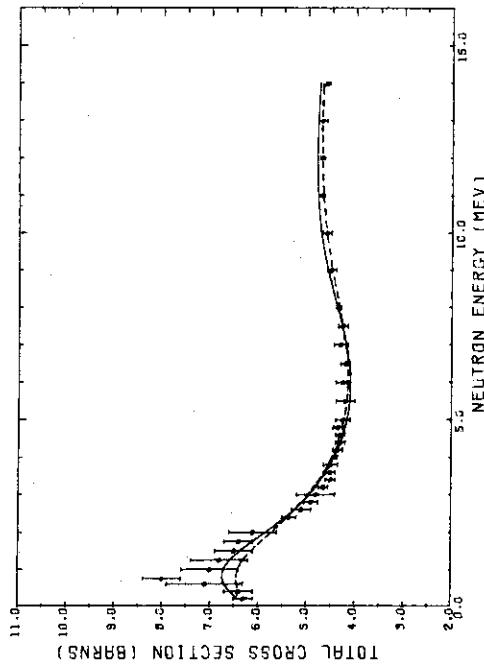


Fig. 3-8. Total cross section for  $\text{Sb}$ . Calculations are performed for  $^{125}\text{Sb}$ . Broken and solid lines are cross section curves obtained with the preliminary and present potential parameters, respectively.

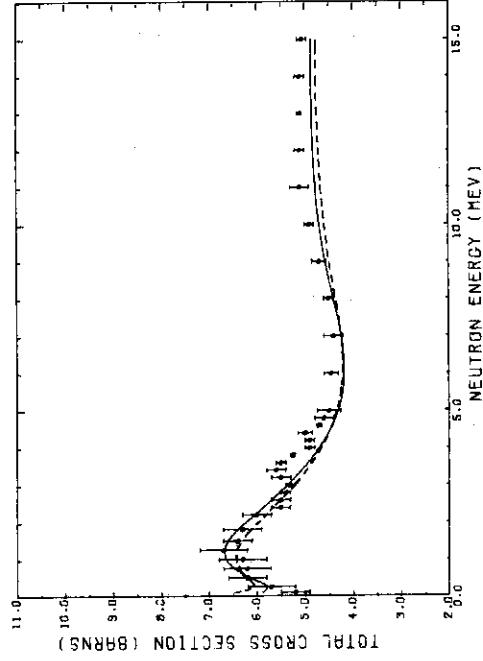


Fig. 3-9. Total cross section for  $^{130}\text{Te}$ . Calculations are performed for  $^{130}\text{Te}$ . Broken and solid lines are cross section curves obtained with the preliminary and present potential parameters, respectively.

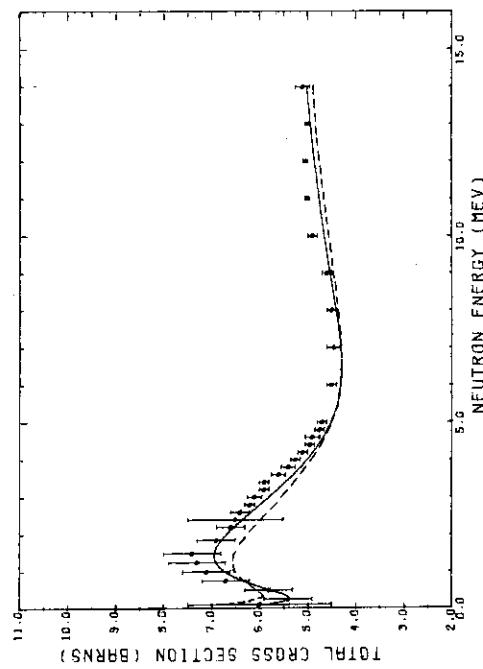


Fig. 3-10. Total cross section for  $\text{Ba}$ . Calculations are performed for  $^{138}\text{Ba}$ . Broken and solid lines are cross section curves obtained with the preliminary and present potential parameters, respectively.

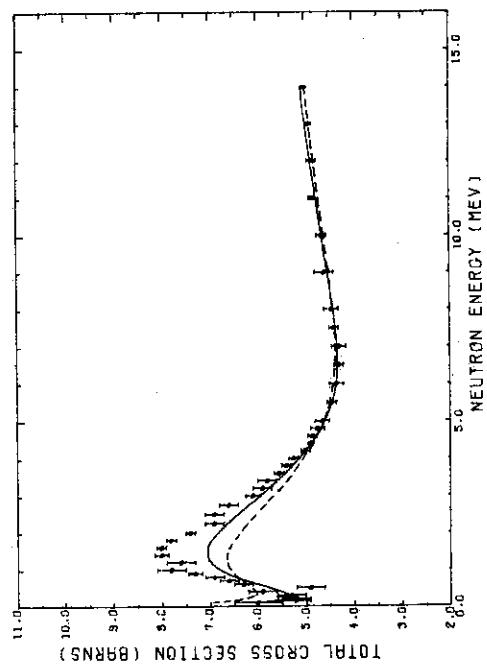


Fig. 3-11. Total cross section for  $\text{Pr}^{141}$ . Calculations are performed for  $141\text{Pr}$ . Broken and solid lines are cross section curves obtained with the preliminary and present potential parameters, respectively.

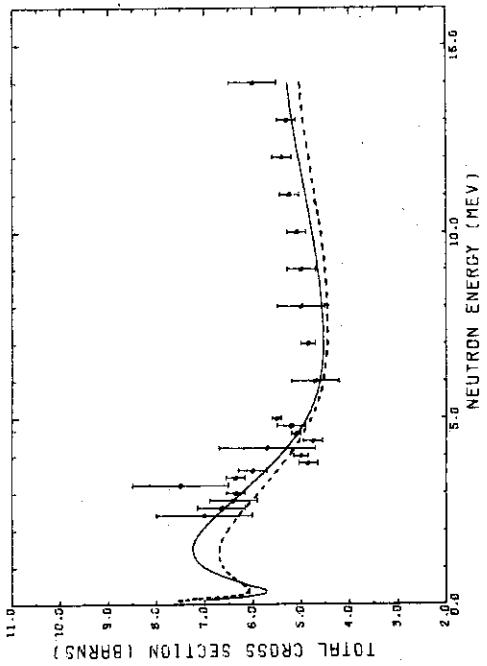


Fig. 3-12. Total cross section for  $\text{Pm}^{147}$ . Calculations are performed for  $147\text{Pm}$ . Broken and solid lines are cross section curves obtained with the preliminary and present potential parameters, respectively.

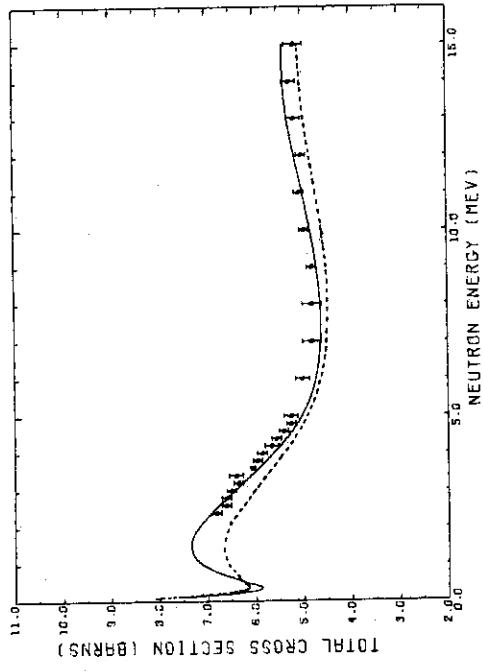


Fig. 3-13. Total cross section for  $\text{Eu}^{153}$ . Calculations are performed for  $153\text{Eu}$ . Broken and solid lines are cross section curves obtained with the preliminary and present potential parameters, respectively.

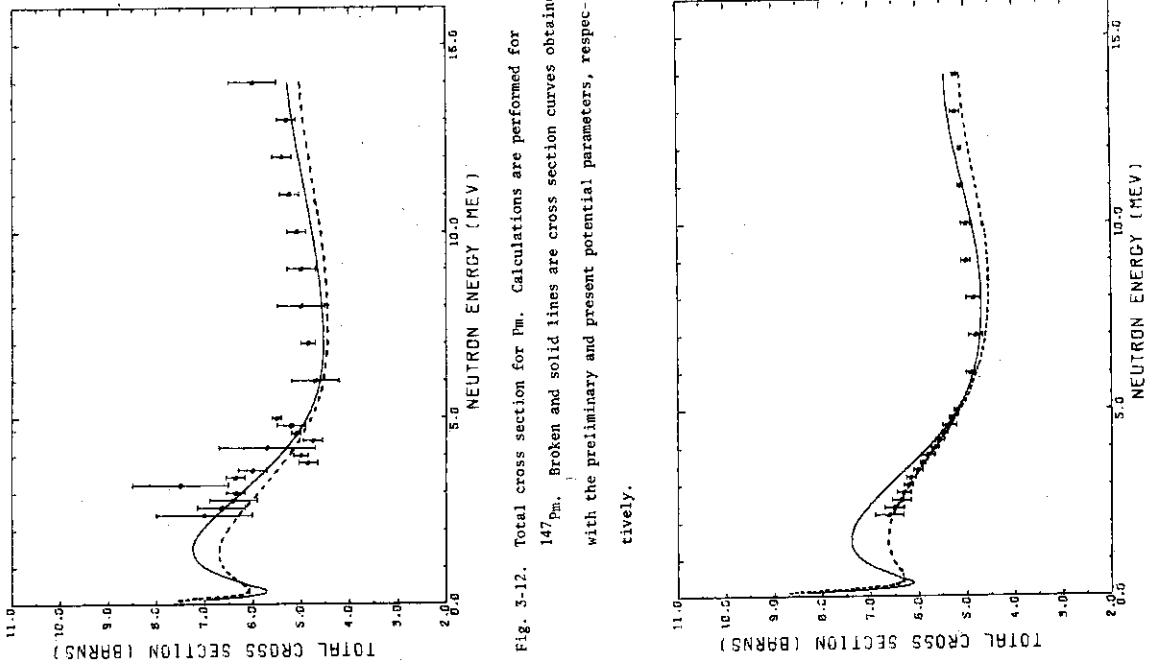


Fig. 3-14. Total cross section for  $\text{Tb}^{159}$ . Calculations are performed for  $159\text{Tb}$ . Broken and solid lines are cross section curves obtained with the preliminary and present potential parameters, respectively.

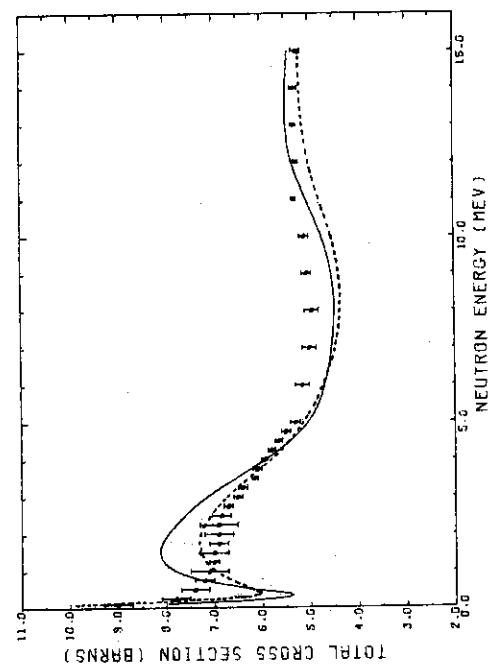


Fig. 3-15. Total cross section for  $^{165}\text{Ho}$ . Calculations are performed for  $^{165}\text{Ho}$ . Broken and solid lines are cross section curves obtained with the preliminary and present potential parameters, respectively.

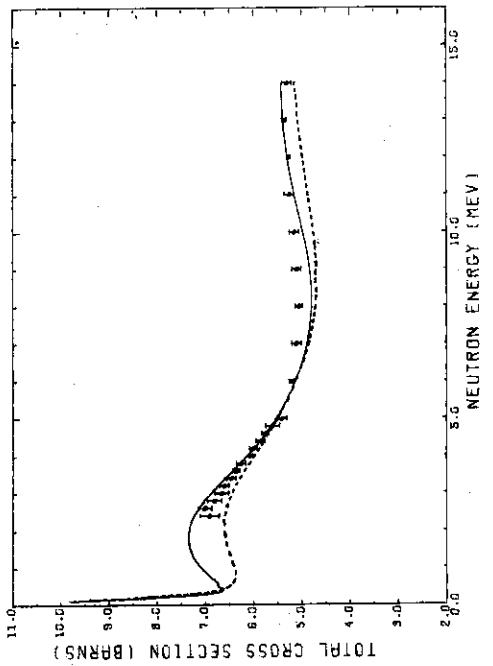


Fig. 3-16. Total cross section for  $^{169}\text{Tm}$ . Calculations are performed for  $^{169}\text{Tm}$ . Broken and solid lines are cross section curves obtained with the preliminary and present potential parameters, respectively.

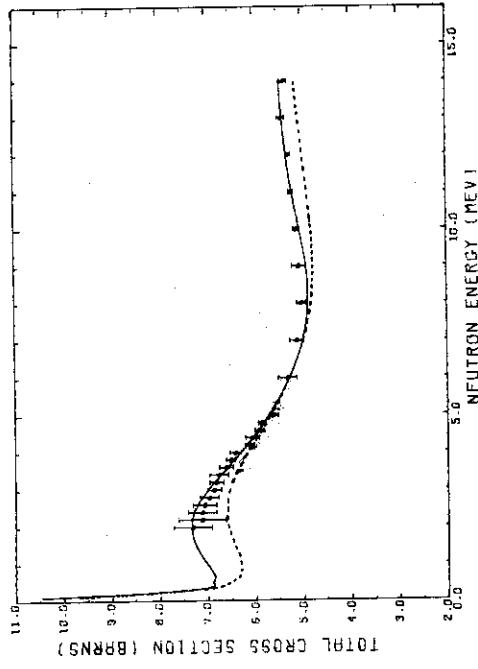


Fig. 3-17. Total cross section for  $^{175}\text{Lu}$ . Calculations are performed for  $^{175}\text{Lu}$ . Broken and solid lines are cross section curves obtained with the preliminary and present potential parameters, respectively.

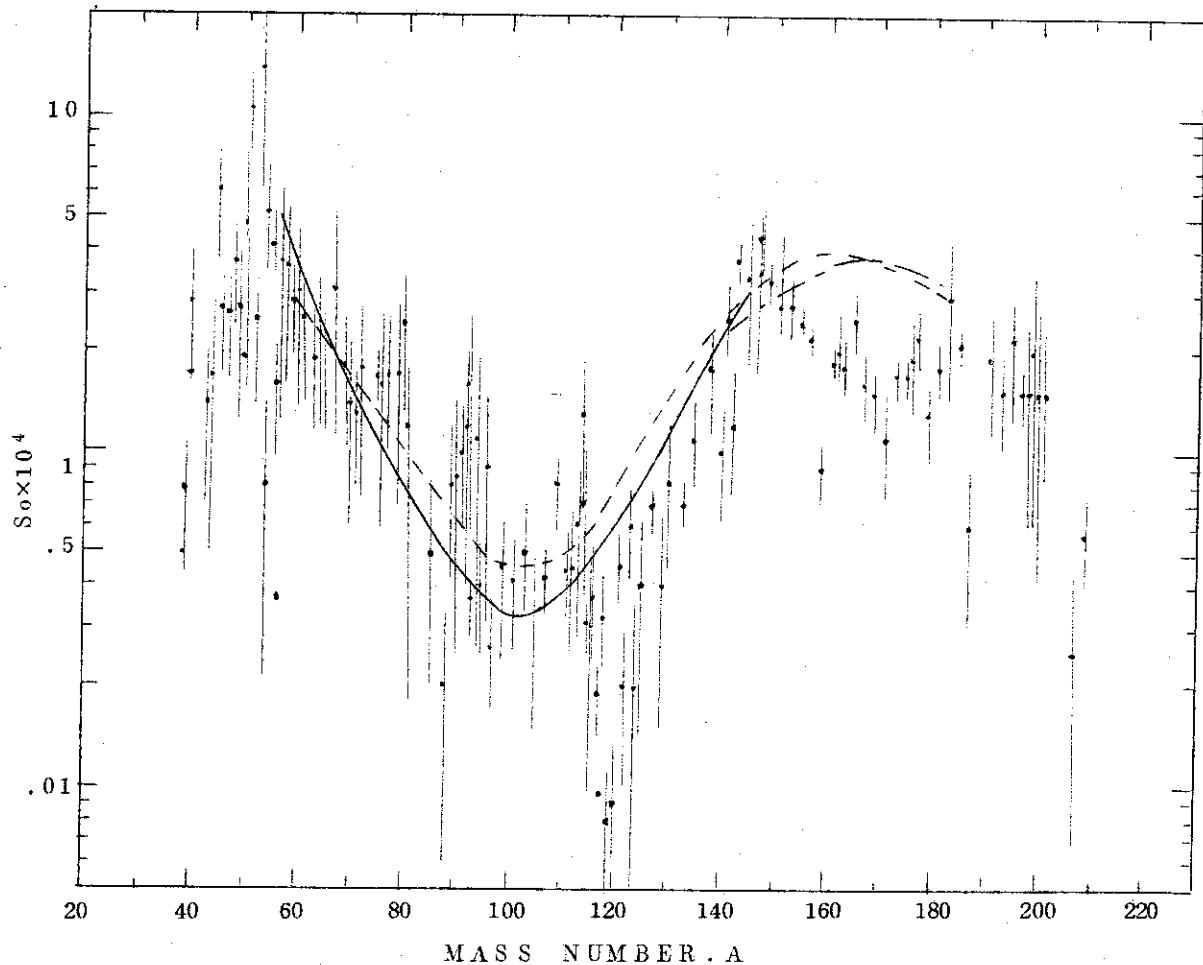


Fig. 3-18 Strength function for s-wave neutron. Calculated values are compared with the data compiled by Lynn<sup>28)</sup>. Broken line is the s-wave neutron strength function obtained with the preliminary potential parameters. Solid and dash-and-dot lines are obtained with the present potential parameters.

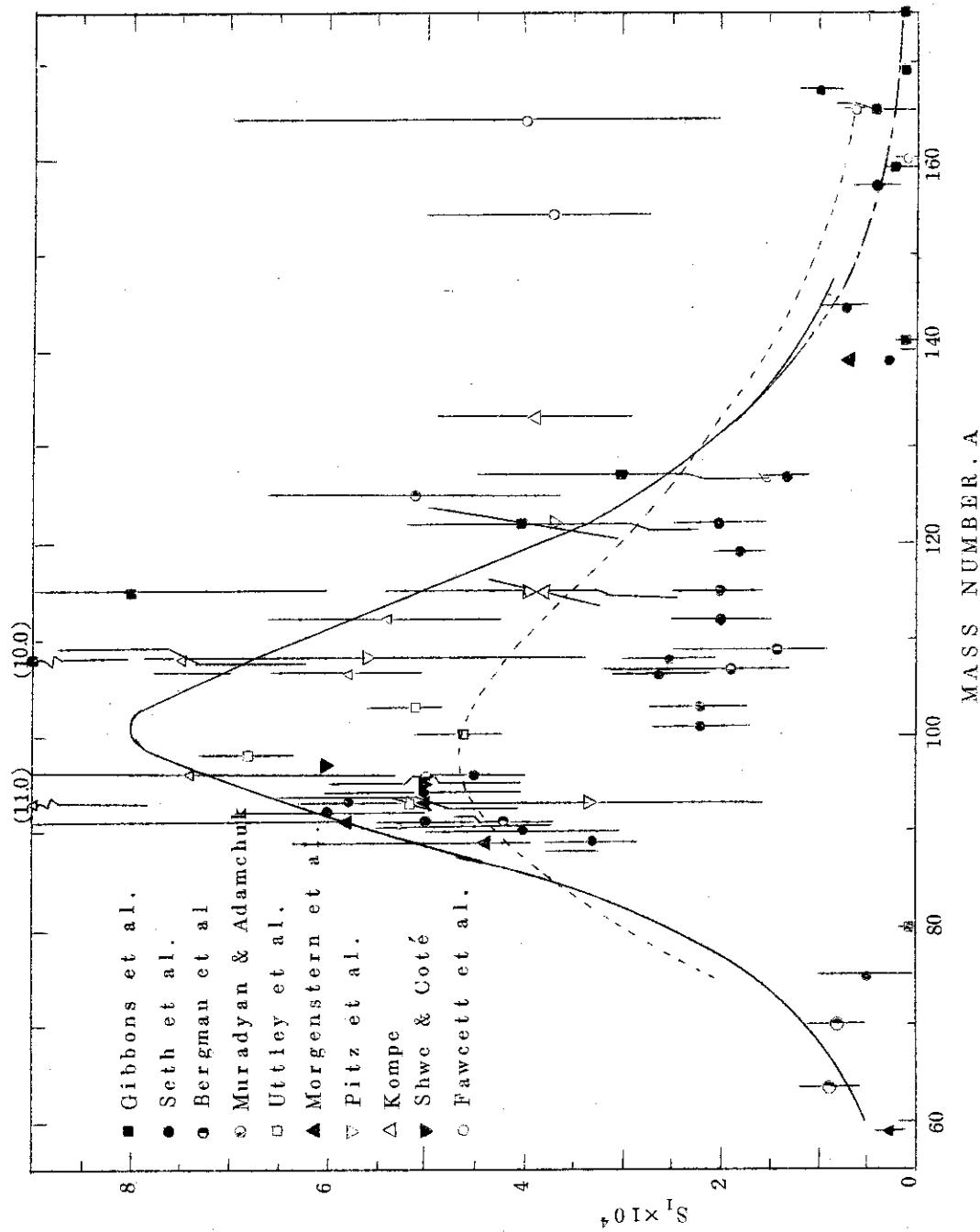


Fig. 3-19 Strength function for p-wave neutron. Calculated values are compared with the experimental data ( $29 \sim 40$ ). Broken line is the p-wave neutron strength function obtained with the preliminary potential parameters. Solid and dash-and-dot lines are obtained with the present potential parameters.

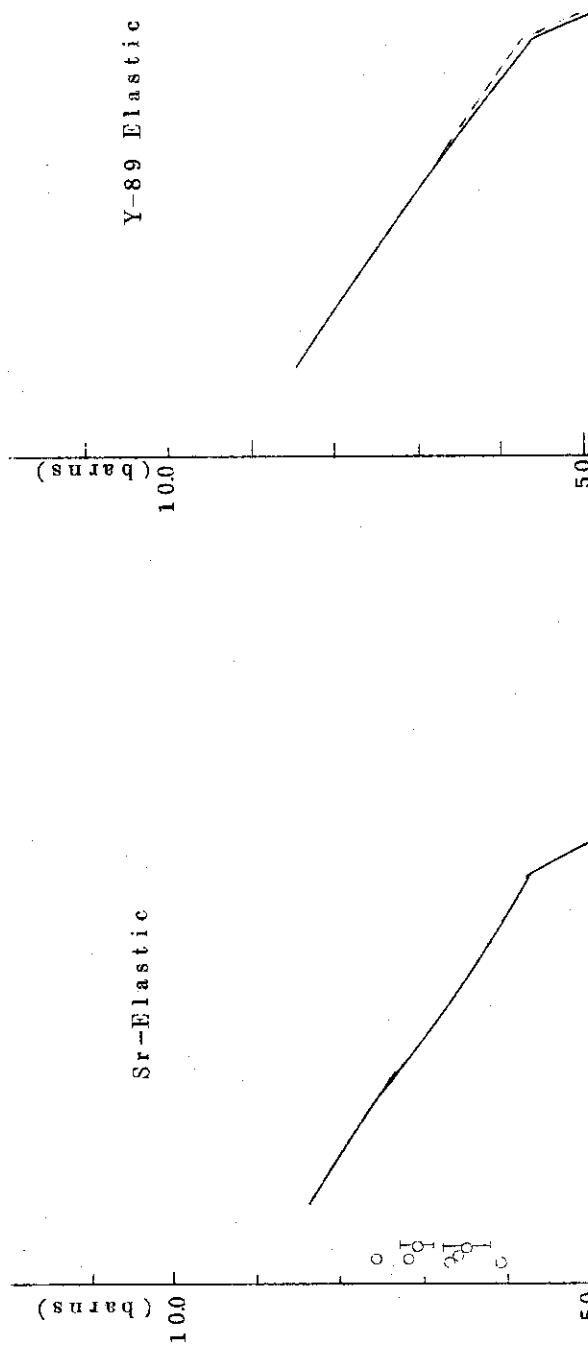


Fig. 3-20 Elastic scattering cross section of neutrons by Sr. Calculated values for Sr-88 are compared with the experimental data (42, 44, 56, 59).

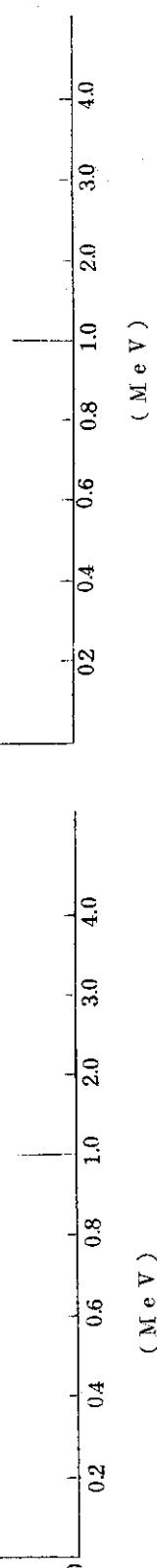


Fig. 3-21 Elastic scattering cross section of neutrons by Y. Calculated values for Y-89 are compared with the experimental data (46, 53, 54, 57).

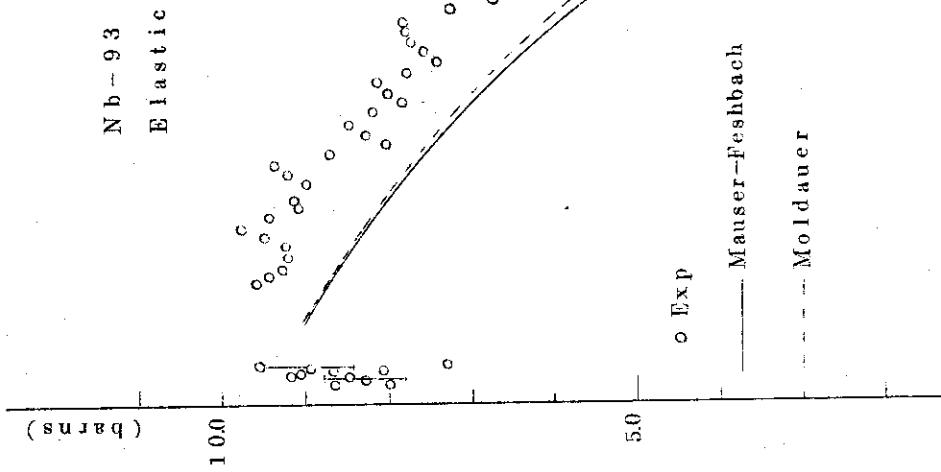


Fig. 3-22 Elastic scattering cross section of neutrons by Nb. Calculated values for Nb-93 are compared with the experimental data(42~44, 47, 55, 56, 61).

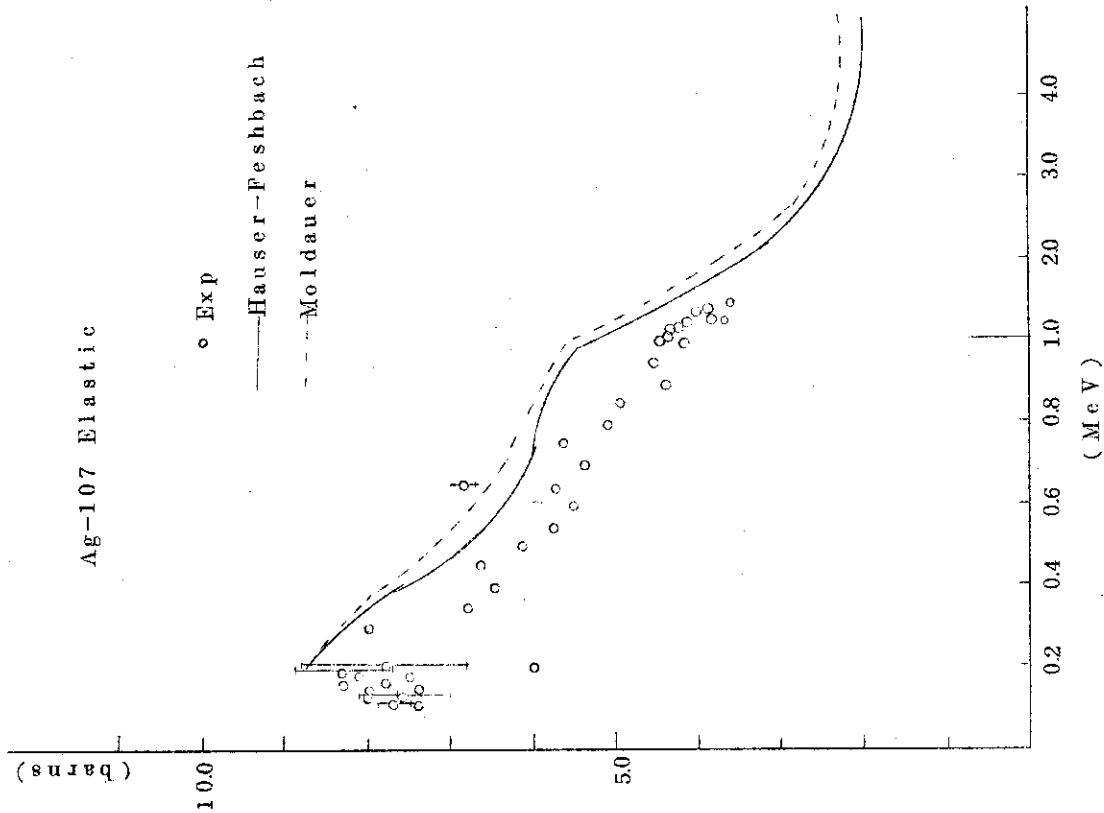


Fig. 3-23 Elastic scattering cross section of neutron by Ag. Calculated values for Ag-107 are compared with the experimental data(42, 45, 56, 63).

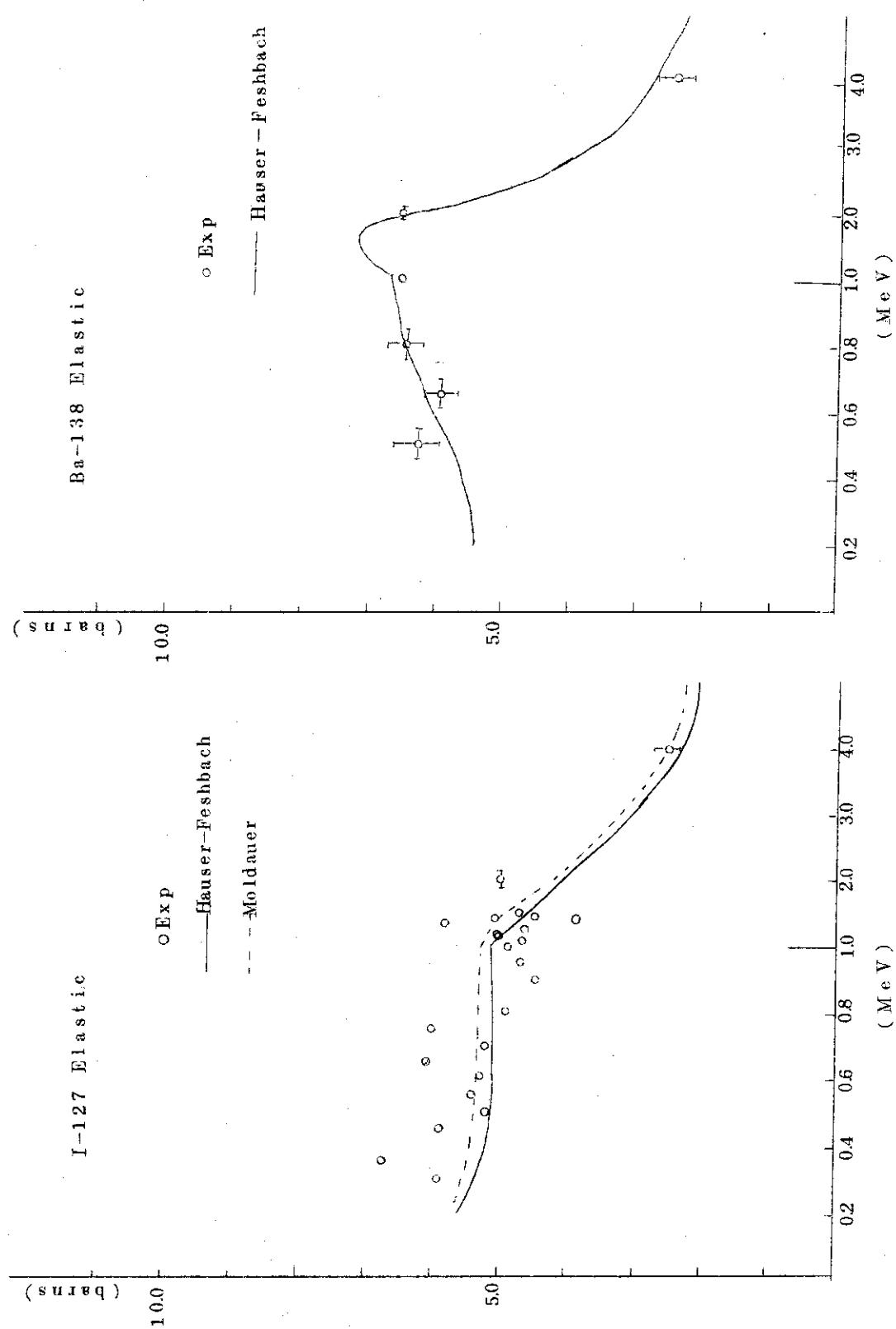


Fig. 3-24 Elastic scattering cross section of neutrons by I. Calculated values for I-127 are compared with the experimental data<sup>43,44,61</sup>.

Fig. 3-25 Elastic scattering cross section of neutrons by Ba. Calculated values for Ba-138 are compared with the experimental data<sup>44,56,58,62,63</sup>.

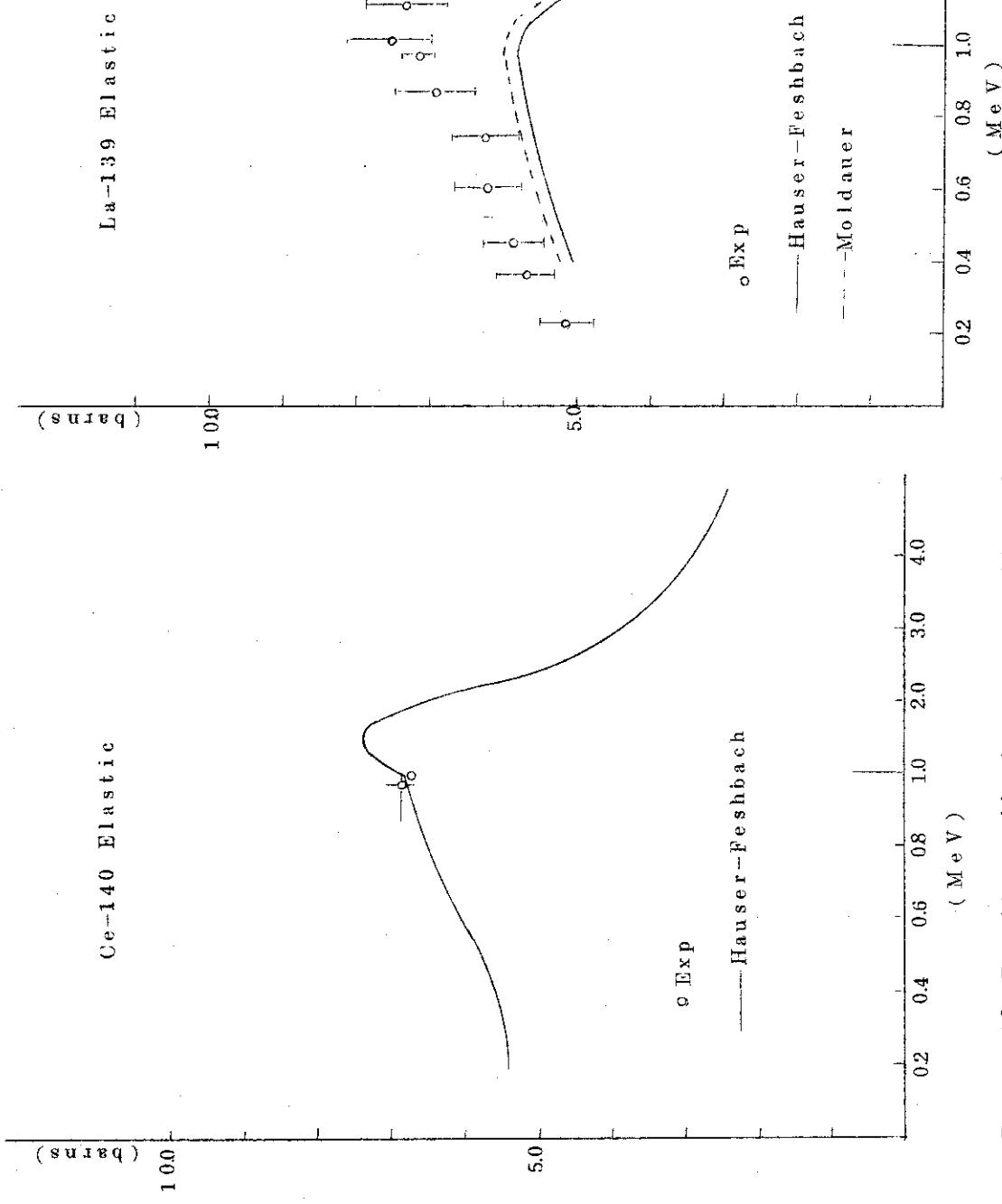


Fig. 3-26 Elastic scattering cross section of neutrons by Ce. Calculated values for Ce-140 are compared with the experimental data<sup>56,60</sup>.  
 Fig. 3-27 Elastic scattering cross section of neutrons by La. Calculated values for La-139 are compared with the experimental data<sup>52,60</sup>.

Fig. 3-27 Elastic scattering cross section of neutrons by La. Calculated values for La-139 are compared with the experimental data<sup>52,60</sup>.

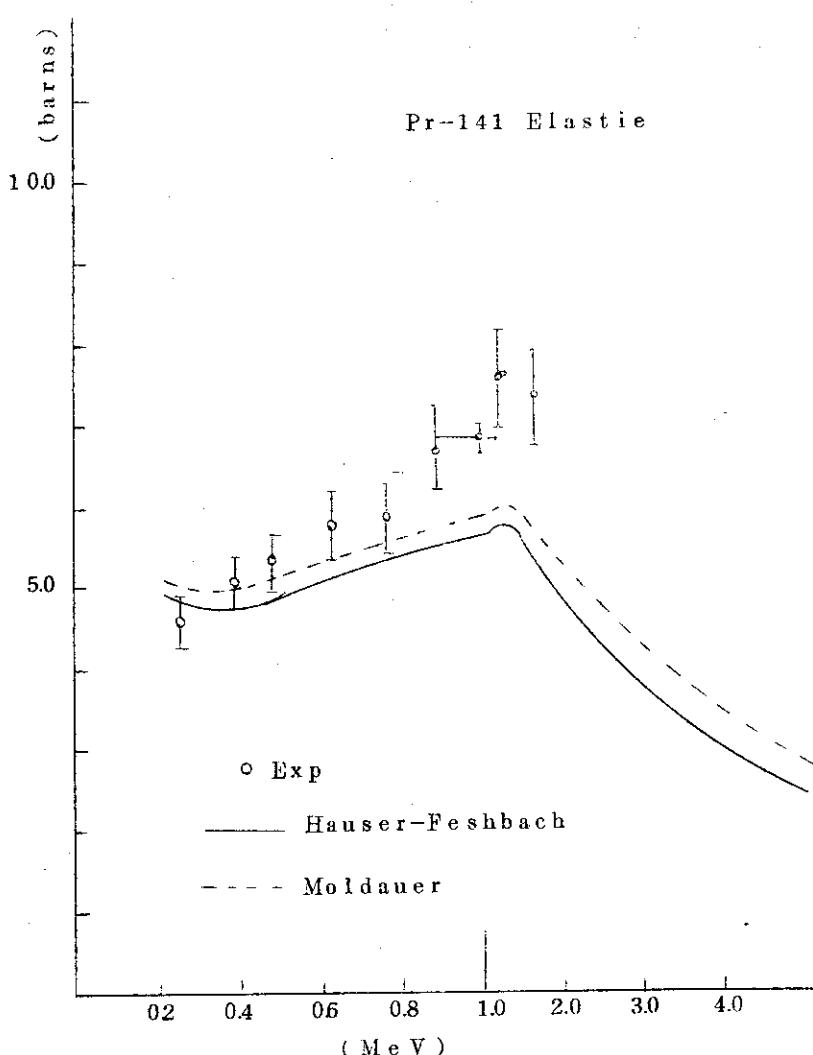


Fig. 3-28 Elastic scattering cross section of neutrons by Pr. Calculated values for Pr-141 are compared with the experimental data<sup>52,60)</sup>.

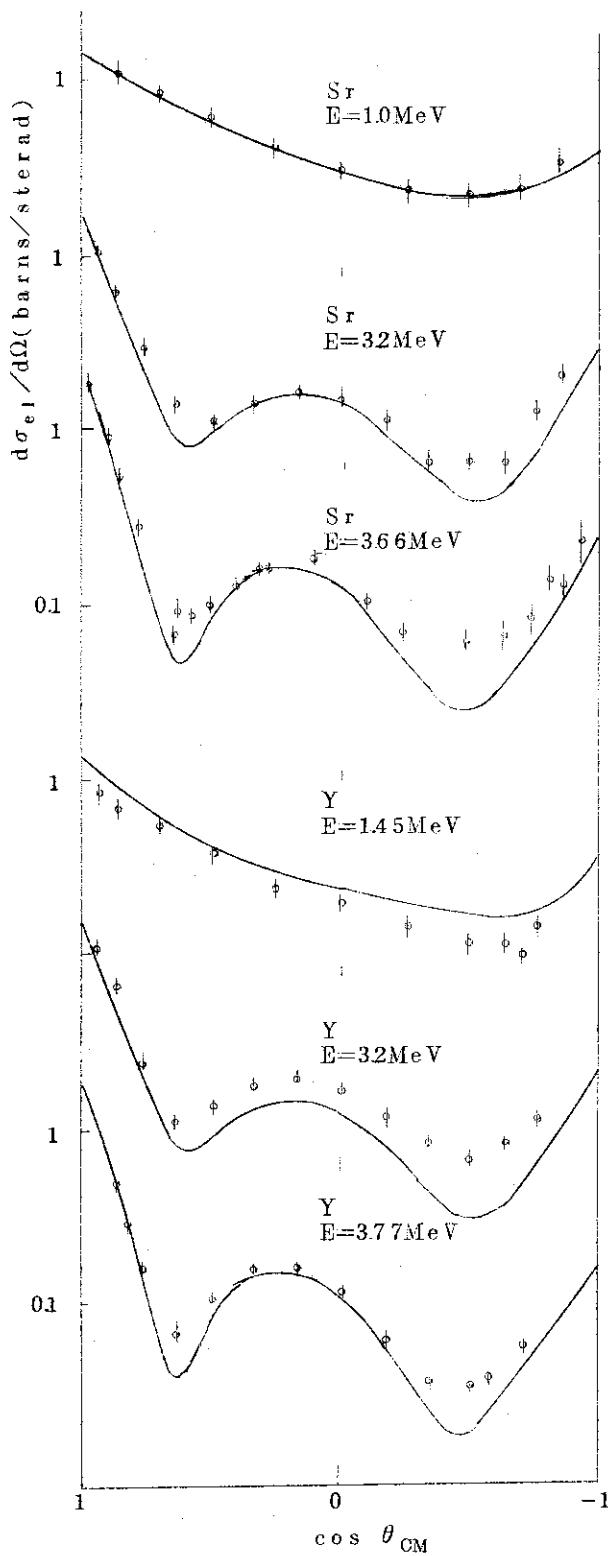


Fig. 3-29 Differential cross sections for elastic scattering of neutrons by Sr<sup>56,59,72)</sup> and Y<sup>54,57,72).</sup> Calculations are performed for Sr-88 and Y-89, respectively.

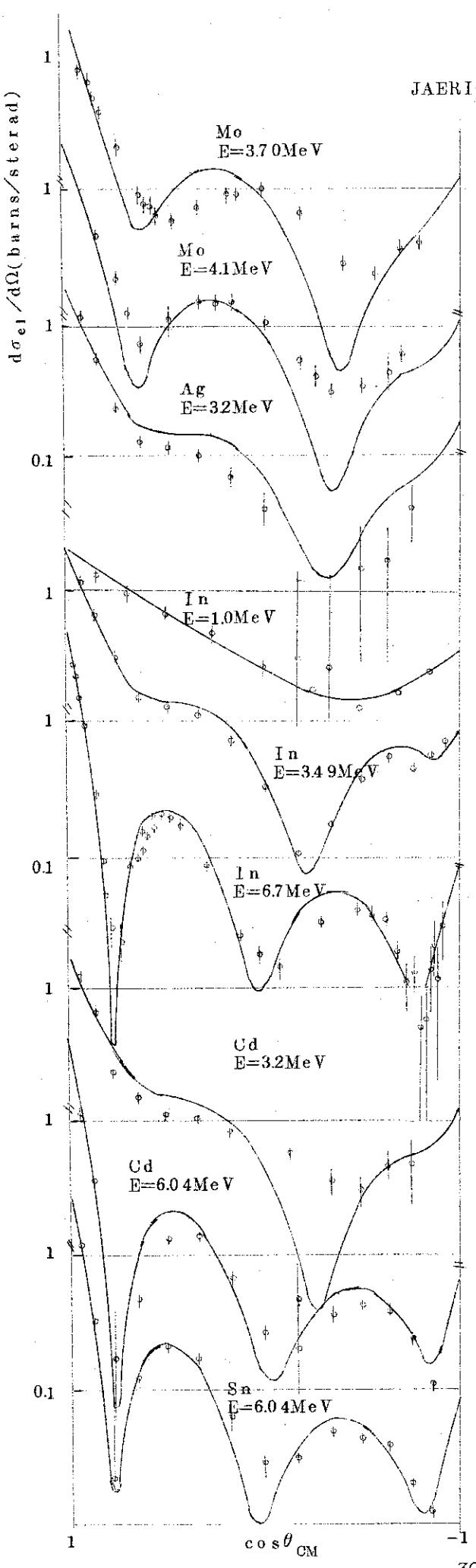


Fig. 3-30 Differential cross sections for elastic scattering of neutrons by Mo<sup>58,66</sup>, Ag<sup>72</sup>, In<sup>56,68,75</sup>, Cd<sup>71,72</sup> and Sn<sup>71</sup>). Calculations are performed for Mo-96, Ag-107, In-115, Cd-112 and Sn-120, respectively.

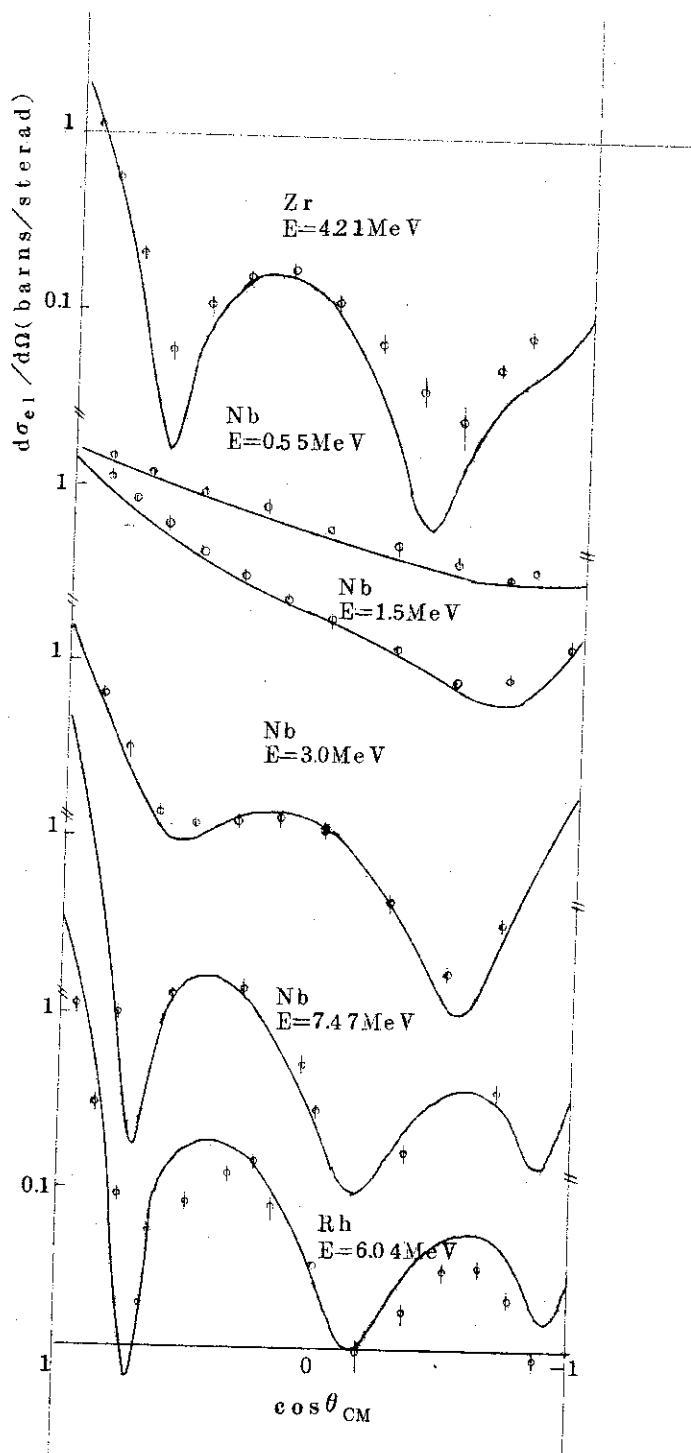


Fig. 3-31 Differential cross sections for elastic scattering of neutrons by Zr<sup>57</sup>, Nb<sup>93,69,76</sup> and Rh<sup>71</sup>. Calculations are performed for Zr-92, Nb-93 and Rh-103, respectively.

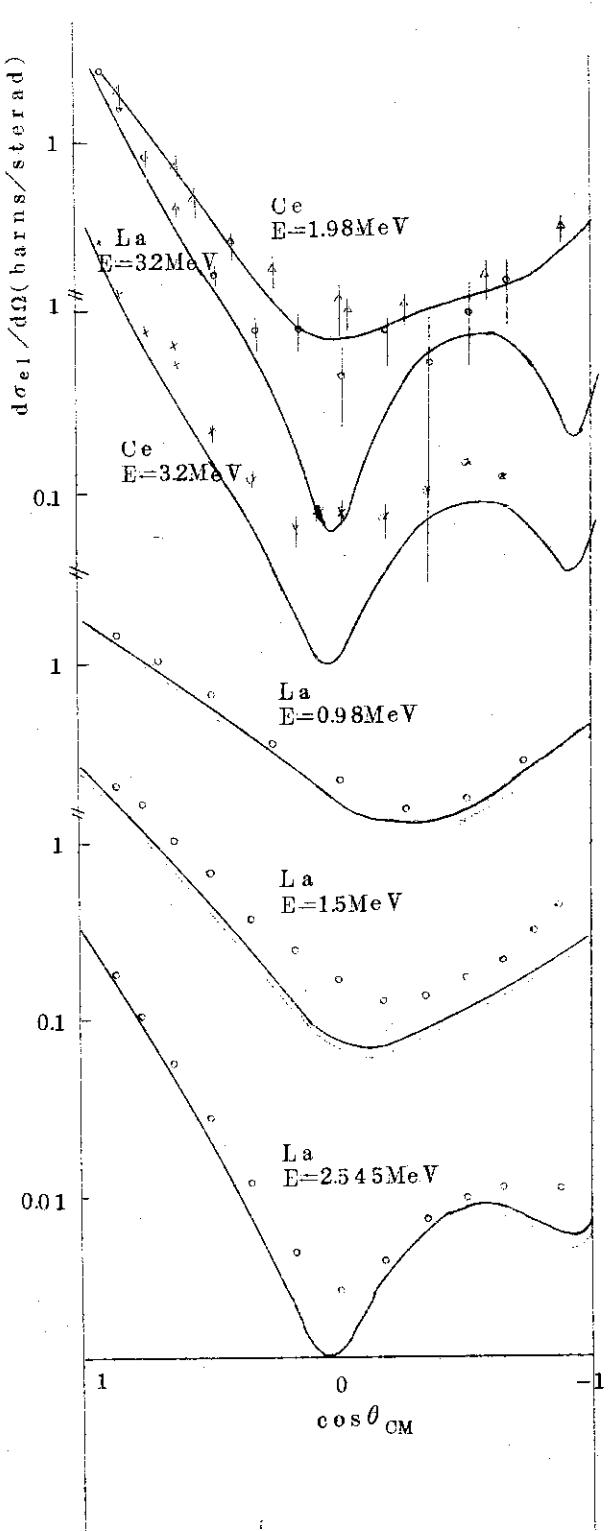


Fig. 3-32 Differential cross sections for elastic scattering of neutrons by  $Ce^{70,72}$ ) and  $La^{60,72,77}$ ). Calculations are performed for  $Ce-140$  and  $La-139$ , respectively.

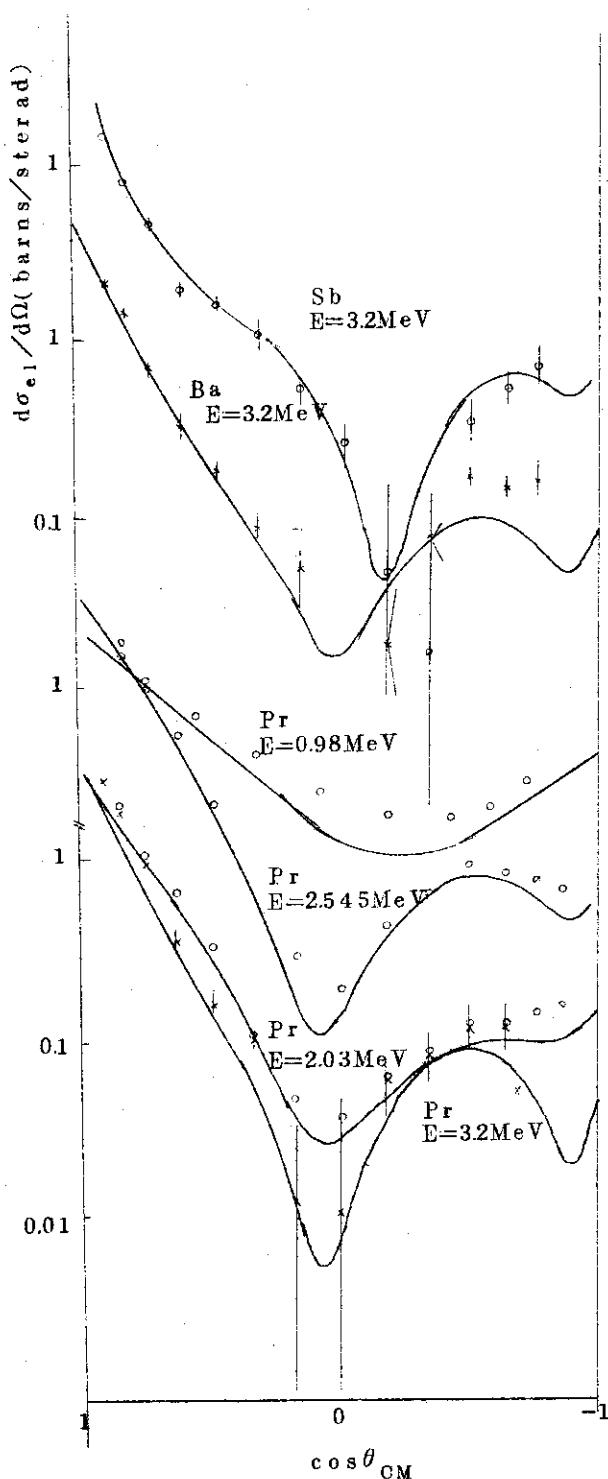


Fig. 3-33 Differential cross sections for elastic scattering of neutrons by  $Sb^{72}$ ,  $Ba^{72}$  and  $Pr^{60,72,77}$ . Calculations are performed for  $Sb-121$ ,  $Ba-138$  and  $Pr-141$ , respectively.

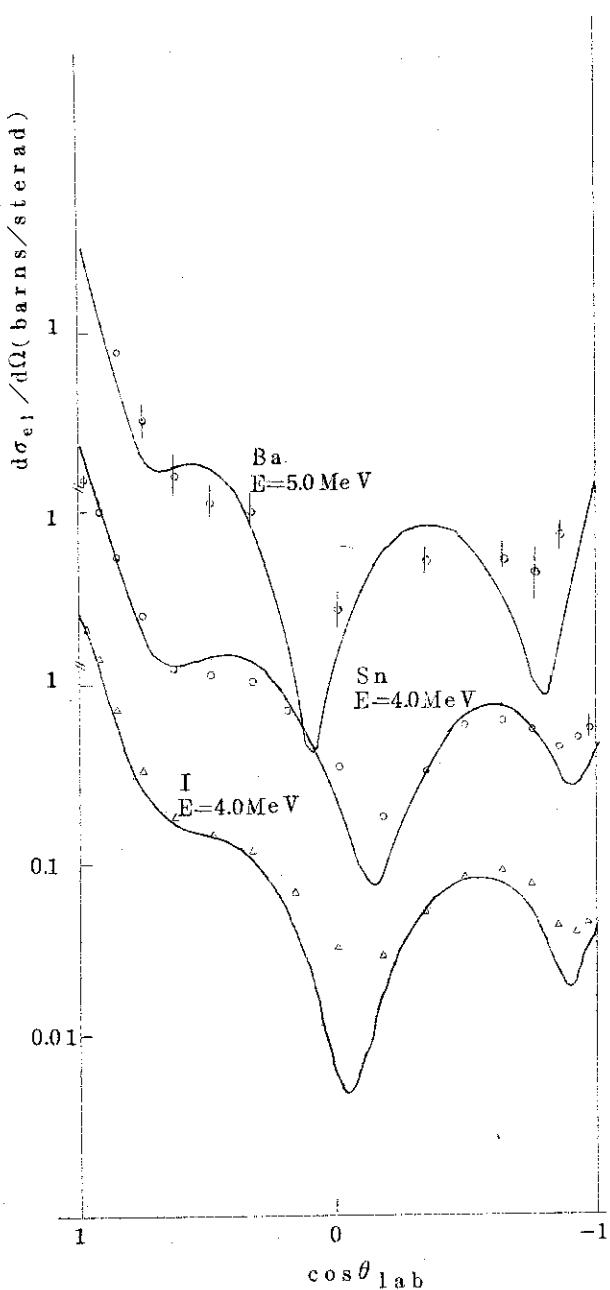


Fig. 3-34 Differential cross sections for elastic scattering of neutrons by  $Ba^{67}$ ,  $Sn^{61}$  and  $I^{61}$ . Calculations are performed for  $Ba-138$ ,  $Sn-118$  and  $I-127$ , respectively.

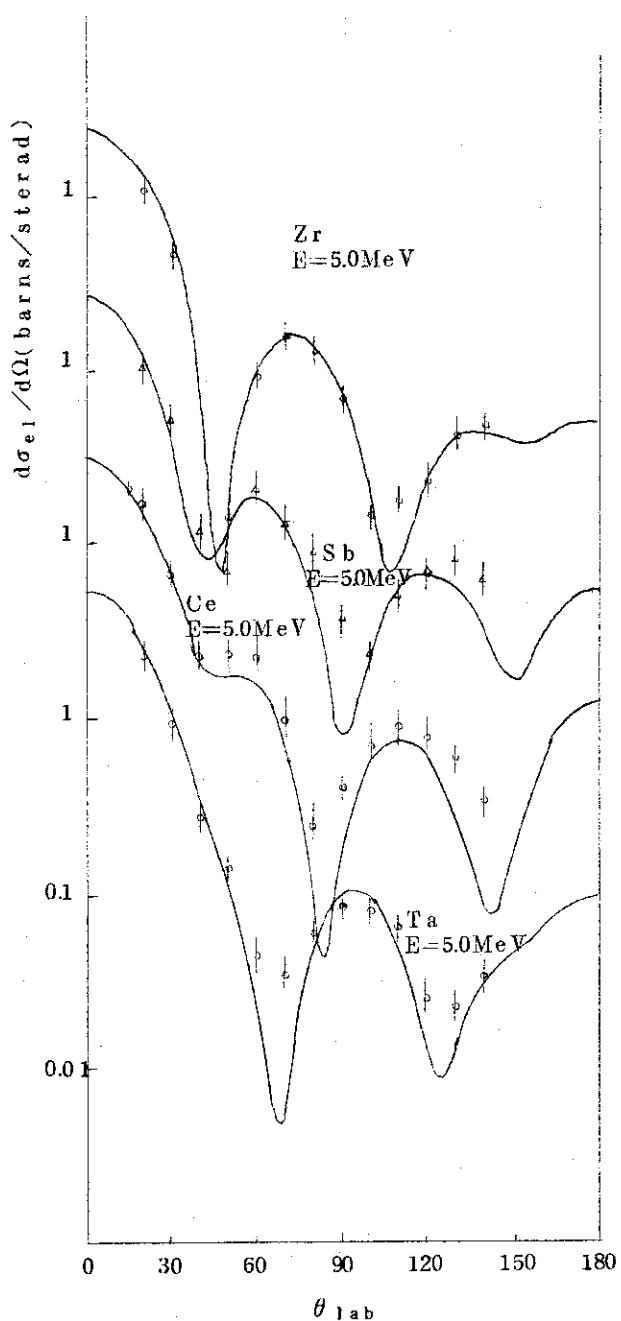


Fig. 3-35 Differential cross sections for elastic scattering of neutrons by  $Zr^{73}$ ,  $Sb^{73}$ ,  $Ce^{73}$  and  $Ta^{73}$ . Calculations are performed for Zr-92, Sb-121, Ce-140 and Ta-181, respectively.

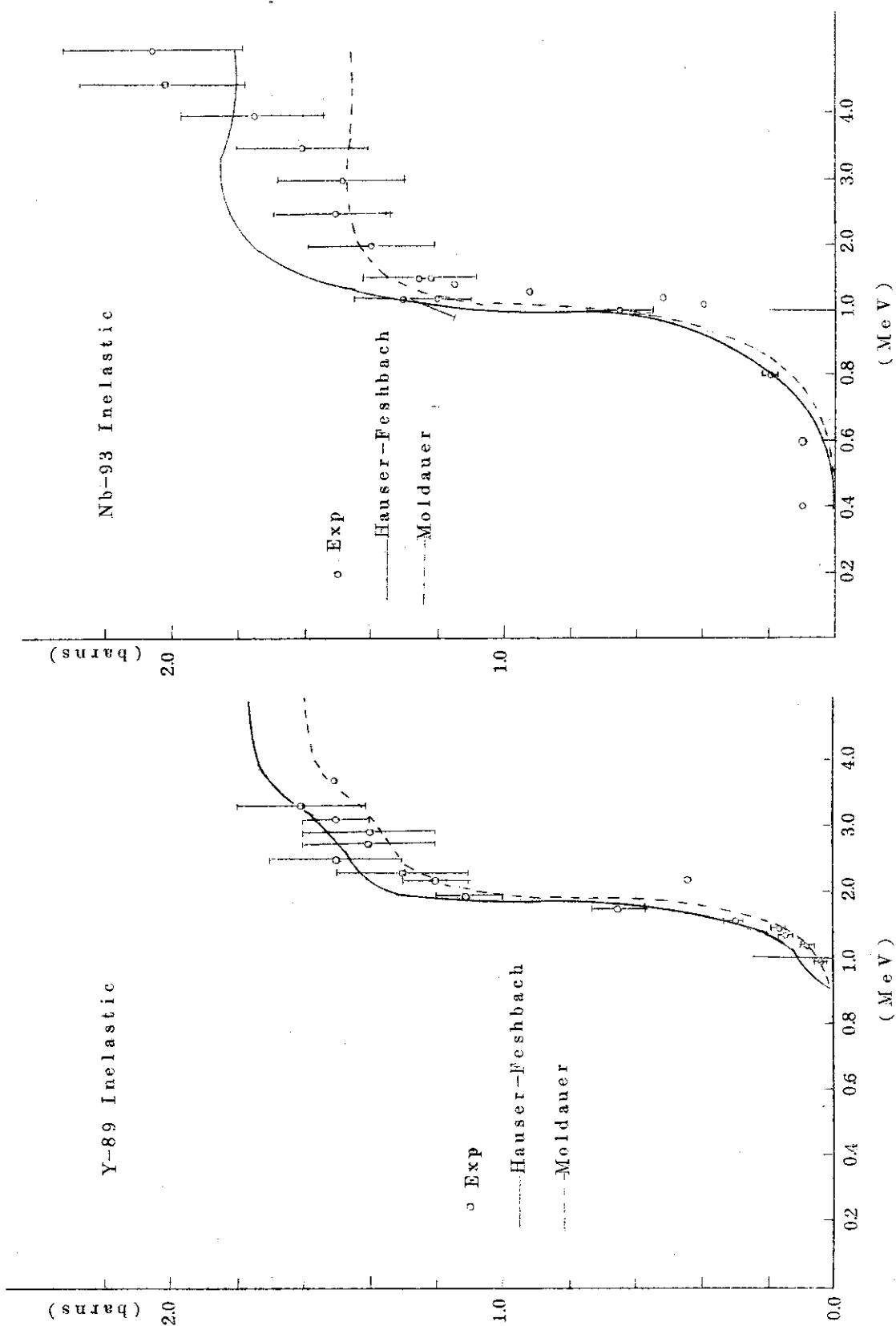


Fig. 3-36 Inelastic scattering cross section of neutrons by  $\text{Y}$ . Calculated values for  $\text{Y-89}$  are compared with the experimental data 48, 53, 54).

Fig. 3-37 Inelastic scattering cross section of neutrons by  $\text{Nb}$ . Calculated values for  $\text{Nb-93}$  are compared with the experimental data 47, 50, 55).

I-127 Inelastic      Ba-138 Inelastic

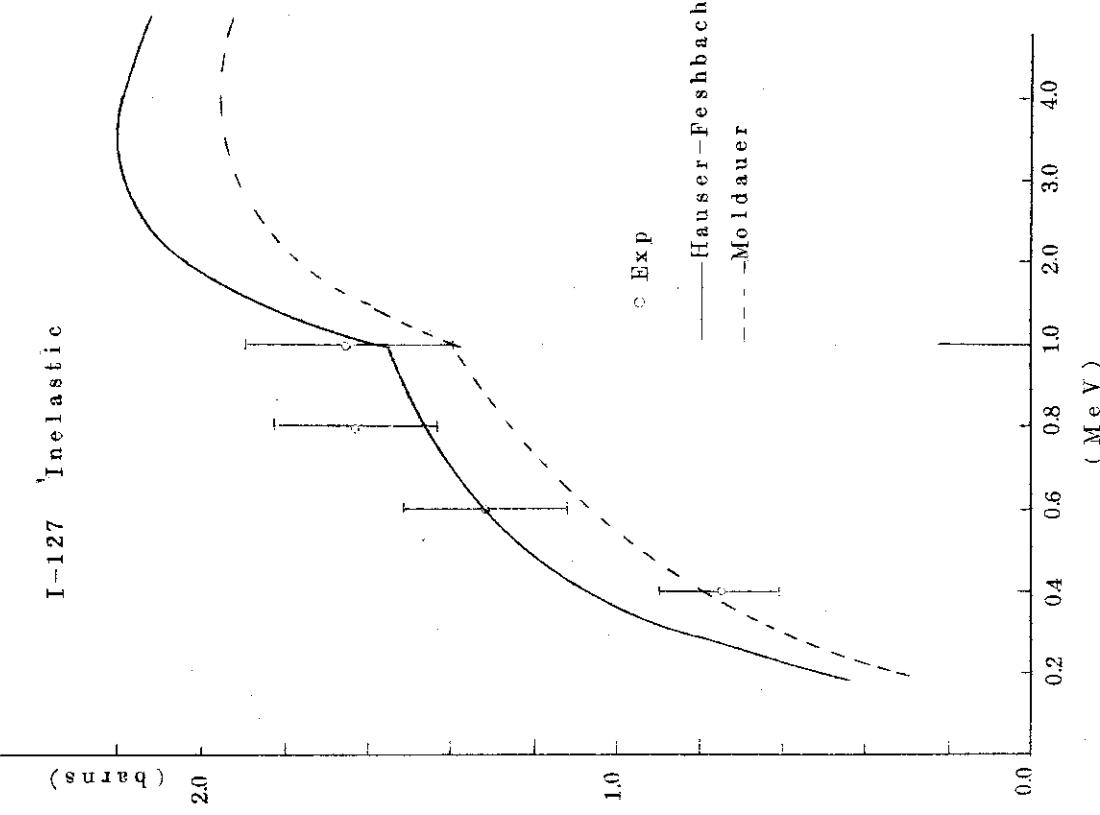


Fig. 3-38 Inelastic scattering cross section of neutrons by I. Calculated values for  $\text{I-127}^{50}$  are compared with the experimental data.

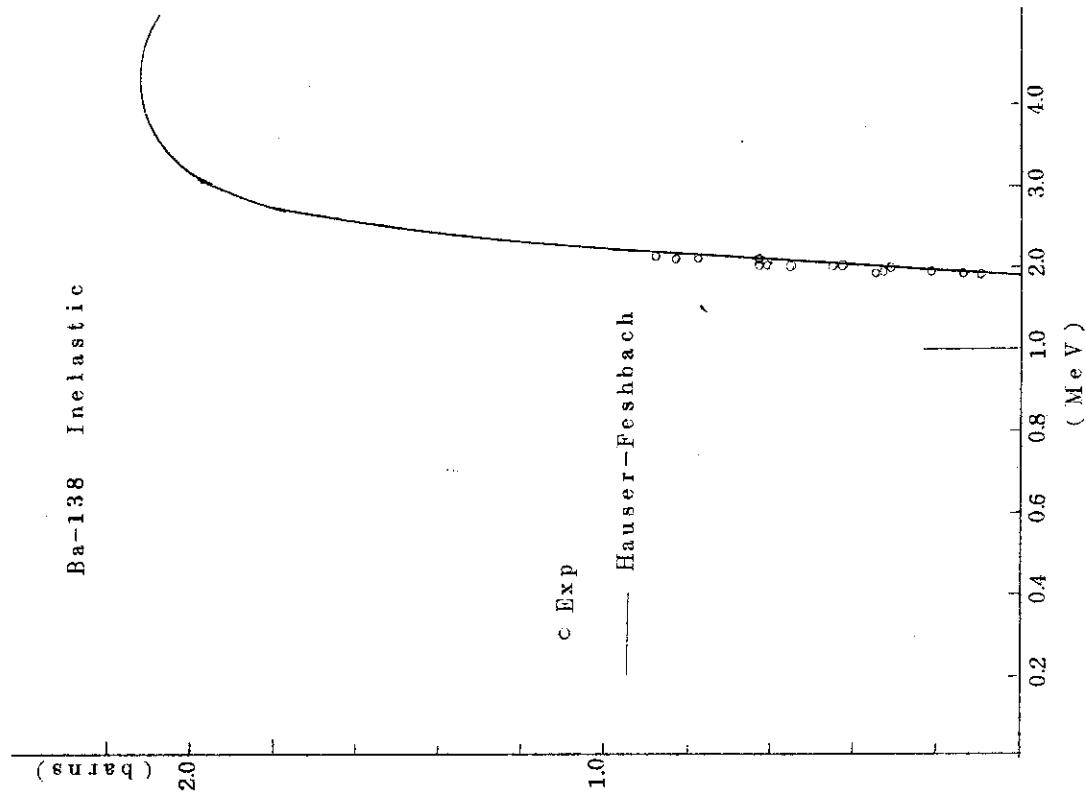


Fig. 3-39 Inelastic scattering cross section of neutrons by Ba. Calculated values for  $\text{Ba-138}^{50}$  are compared with the experimental data.

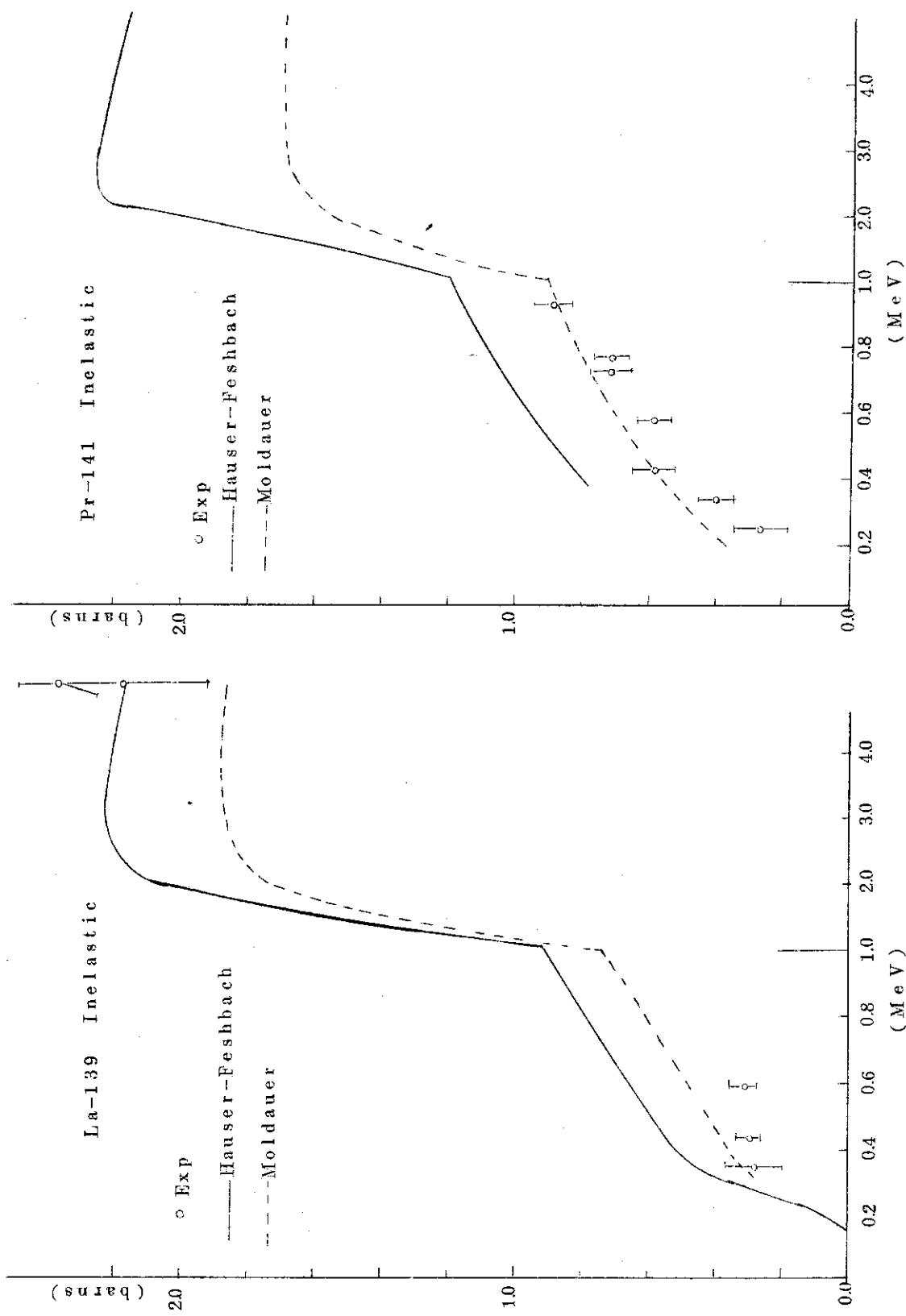


Fig. 3-40 Inelastic scattering cross section of neutrons by La. Calculated values for La-139 are compared with the experimental data<sup>49,51,52).</sup>

Fig. 3-41 Inelastic scattering cross section of neutrons by Pr. Calculated values for Pr-141 are compared with the experimental data<sup>52).</sup>

#### 4. Physics Parameters

##### 4.1 Level Scheme

On the one hand, in calculating the cross section of inelastic scattering by means of the Hauser-Feshbach method,<sup>7)</sup> it is necessary to know the properties of the ground state and several low-lying levels. Since the evaporation-model calculation can be applied to the region of higher excitation energy, it is not necessary to know the spins and parities of so many excited levels. Even so, however, one had better include at least 10 to 15 lower-lying levels in the calculations based on the Hauser-Feshbach method. The reason is as following. It has been informed recently<sup>81)</sup> that the addition of one more level to the previously known several excited states affects considerably the calculated cross section in special case. This implies that the spin and parity assignments for the levels may have important effect on the cross sections calculated by using the Hauser-Feshbach method. However, it can be expected that the effect of spin and parity assignments on the calculated cross section may be reduced if much more levels with known properties are included in the calculation.

On the other hand, it seems to be rather exceptional case where the spin and parity assignments for all lower-lying levels, say about 10 levels, are established without any ambiguity. This is because it is not always the case where each of these levels is connected successively to other level(s) by known types of beta, electron-capture, or gamma transitions and/or by reaction processes. Even if this is the case, the consistent spin and parity assignments based on all available information are not so easy.

In the present work, we are dealing not with making the level schemes but with assignning the spin and parity for each of the excited levels as many as possible in order to use them for the calculations of the cross sections. Since the evaluated level schemes in Nuclear Data Sheets (NDS) or compiled ones published in Table of Isotopes<sup>82)</sup> (TIS) do not satisfy fully our requirements, we are obliged to make spin and parity assignments by ourselves by means of a brute force method. Although this job was not so familiar to the members of our working group, enough time was not available for this purpose by some reasons.

Under such severe conditions, we surveyed quickly the literatures listed in Recent References of Nuclear Data Sheets in order to add possible new information to those appeared in Nuclear Data Sheets and in Table of Isotopes. This must be, however, still considered to be incomplete because

of several missing journals and of many unavailable reports or documents. In the present work, less cares have been taken about the excitation energies of the levels, the places and the branching ratios of betas and gammas, and the angular distribution analyses in reaction data. For these data, published ones were assumed to be reliable unless serious contradiction exists between the publications. In some cases, quite insufficient information limited possible spin and parity assignments to only a few levels. However, we did not make spin and parity assignments by our speculation in such cases unless theoretical prediction or some systematics, even though it is quite weak, can be used. We have therefore given up in assigning the spins and parities for at least 10 levels in such cases.

$^{38}\text{Sr}^{90}$ 

TIS <sup>82)</sup>	NDT A8 <sup>83)</sup>	Benzi <sup>2)</sup>		Adopted	
0.00 0+	0.00 0+	0.00	0+	0.00	0+
0.83 (2+)	0.8315 (2+)			0.8315	2+
1.69	1.6555	1.752	0+	1.6555	0+
1.94	1.8921	2.182	2+	1.8921	2+
2.23	2.2068 (4+)	2.315	5-	2.2068	4+
3.07	2.4972	2.74	4-		
3.34	2.5271	2.75	3-		
4.15	2.5712	3.081	4+		
4.34	2.9275	3.29	2+		
4.60	3.0385	3.453	6+		
5.08		3.595	8+		
5.23	(many others)	3.92	3+		

As stated in NDT,<sup>83)</sup> the 1.6555, 1.8921 and 2.2068 MeV levels may be considered to be a two-phonon triplet with 0+, 2+ and 4+, respectively, if the 0.5514 MeV  $\gamma$  is moved to other place in consistent way with the coincidence data.

The spin and parity assignments for much more levels up to about 5 MeV could be possible based on log ft values, if further relocation of several  $\gamma$ 's is allowed. This, however, seems to require much time.

 $^{40}\text{Zr}^{93}$ 

TIS <sup>82)</sup>	NP A169 <sup>84)</sup>	Benzi <sup>2)</sup>		Adopted	
0.00 5/2+	0.00 5/2+		(none)	0.00	5/2+
0.267 (3/2+)	0.267 3/2+			0.267	3/2+
0.94 (1/2)+	0.947 1/2+			0.947	1/2+
	(1.168) (7/2, 9/2+)		(left out)		
1.42 (3/2+)	1.425 (1/2, 3/2, 5/2+)			1.425	5/2+
	1.451 (1/2, 3/2, 5/2+)			1.451	3/2+
1.64 (7/2+)	1.652 7/2+			1.652	7/2+
1.89 (1/2+)	1.910 (1/2, 3/2, 5/2+)			1.910	1/2+
2.08 (7/2+)	1.993 (1/2, 3/2, 5/2+)			1.993	5/2+
2.18	2.181 (1/2, 3/2+)			2.181	1/2+
2.32 (7/2+)	(2.350) (1/2, 3/2, 5/2+)		(left out)		
2.44 (3/2+)	2.453 (1/2, 3/2+)			2.453	1/2+
	2.468 (1/2, 3/2+)			2.468	3/2+
	2.605 (1/2, 3/2, 5/2+)			2.605	1/2+
2.78 (3/2+)	2.773 (1/2, 3/2+)			2.773	3/2+

The selections of unique spin-value for several levels have been done by referring the (d,p) and (d,t) data of B.L. Cohen and O.V. Chubinsky (Phys. Rev. 131 (1963) 2187).<sup>85)</sup>

Note added in proof Recently an extensive (d,p) data up to about 5 MeV have been published (C.R. Bingham and G.T. Fabian, Phys. Rev. C7 (1973) 1509).<sup>86)</sup> As is expected, several high spin levels which are hardly populated from the decay of  $^{93}\text{Y}$ , have been reported, and spin assignments have been done by DWBA analyses.

$^{42}\text{Mo}^{95}$ 

TIS <sup>82)</sup>	NDS <u>B8</u> <sup>87)</sup>	Benzi <sup>2)</sup>	Adopted
0.00 5/2+	0.00 5/2+	0.00 5/2+	0.00 5/2+
0.2042 3/2+	0.20394 3/2+	0.2040 3/2+	0.20394 3/2+
0.68		0.68 5/2+	
0.763		0.763 3/2+	
0.765 7/2+	0.76583 7/2+	0.765 7/2+	0.76583 7/2+
0.784		0.784 3/2+	
0.788 1/2+	0.7862 1/2+	0.788 1/2+	0.7862 1/2+
0.822 (3/2,5/2+)	0.82065 (3/2,5/2+)	0.822 3/2+	0.82065 3/2+
0.84		0.840 7/2+	
0.93	0.9478 9/2+	0.930 5/2+	0.9478 9/2+
1.042 (1/2,3/2+)	1.0391 1/2+	1.042 1/2+	1.0391 1/2+
1.06	1.059 (3/2,5/2+)	1.060 7/2+	1.059 5/2+
	1.0741 (7/2)+		1.0741 7/2+
	1.2225		1.2225 5/2+
1.27 (1/2+)	1.310 1/2+		1.310 1/2+
1.39 (5/2+)	1.376 (3/2,5/2)+		1.376 3/2+
	1.433 (3/2,5/2)+		1.433 5/2+
	1.541 (11/2+)		1.541 11/2+
	1.5528 (9/2+)		1.5528 9/2+
1.63 (5/2+)	1.6202 (3/2,5/2+)		
	(many others)		

The spins of the 0.82065, 1.059 and 1.2225 MeV levels have been determined in taking account of log ft and of the evidence for weak electron-capture transitions. The reaction- $\gamma$  data (L. Mesko, A. Nilsson and S.A. Hjorth, Nucl. Phys. A181 (1972) 566) have been used in selecting the spin values for the 1.376 and 1.433 MeV levels.

 $^{42}\text{Mo}^{97}$ 

TIS <sup>82)</sup>	PR <u>C5</u> <sup>89)</sup> + NP <u>A181</u> <sup>88)</sup>	Benzi <sup>2)</sup>	Adopted
0.00 5/2+	0.00 5/2+	0.00 5/2+	0.00 5/2+
	0.4809 3/2+		0.4809 3/2+
0.665 (7/2)+	0.6582 7/2+	0.67 7/2+	0.6582 7/2+
	0.6796 1/2+	0.695 1/2+	0.6796 1/2+
0.70	0.7190 (3/2,5/2)+	0.705 5/2+	0.7190 5/2+
	0.7211 (1/2,3/2,5/2)+		0.7211 3/2+
0.89 (1/2+)	0.8880 1/2+	0.890 1/2+	0.8880 1/2+
1.02	1.0246 (7/2,9/2)+	1.02 5/2+	1.0246 7/2+
	1.0926 (3/2,5/2)+		1.0926 3/2+
	1.1167 (7/2,9/2)+		1.1167 9/2+
1.27 (3/2+)	1.2688 (7/2,9/2)+	1.27 3/2+	1.2688 7/2+
	1.2845 (3/2+)		1.2845 3/2+
	1.4095 11/2+	1.445 1/2+	1.4095 11/2+
1.45	1.4373 (11/2-)	1.455 5/2+	1.4373 11/2-
	1.5156 (7/2,9/2)+		1.5156 9/2+
1.55 (7/2-)	1.5452 (9/2,11/2)	1.55 7/2-	
	(a few more levels)		

Data on reaction- $\gamma$ 's by C.W. Lederer, J.M. Jaklevic and J.M. Hollander (Nucl. Phys. A169 (1971) 489) has been used to select the spin values.

$Tc^{99}$   
43

TIS <sup>82)</sup>	NDS(old)	NP <u>A139</u> <sup>91)</sup> + NP <u>A179</u> <sup>92)</sup>	Benzi <sup>2)</sup>	Adopted
0.00 9/2+	0.00 9/2+	0.00 9/2+		0.00 9/2+
0.1405 7/2+	0.140 7/2+	0.14051 7/2+		0.14051 7/2+
0.1427 1/2-	0.142 (7/2+)	0.14263 1/2-		0.14263 1/2-
0.1811 5/2+	0.181 (5/2+)	0.18107 5/2+		0.18107 5/2+
0.513	0.514	0.5091 3/2-	(none)	0.5091 3/2-
		0.5343		0.5343 5/2-
		0.6715 5/2-		0.6715 5/2-
		0.7263 (7/2, 9/2)+		0.7263 7/2+
		0.7616 (5/2, 7/2, 9/2)+		0.7616 5/2+
0.922 (3/2+)	0.92 (1/2, 3/2)	0.9205 (1/2, 3/2)+		0.9205 3/2+
		1.0040 3/2-		1.0040 3/2-
		1.0729 5/2-		1.0729 5/2-
1.11	1.131	1.1293 (1/2, 3/2)-		1.1293 1/2-
		1.1420 3/2-		1.1420 3/2-
		1.199 (1/2, 3/2)-		1.199 3/2-

The 0.5343 and 0.7616 MeV have been assigned as 5/2- and 5/2+, respectively, since the log ft values suggest unique first forbidden and non-unique second forbidden transitions for respective case. For the 0.7263, 0.9205, 1.1293 and 1.199 MeV levels, no strong argument exists to select the one from the possible spin values.

 $Ru^{101}$   
44

TIS <sup>82)</sup>	NP <u>A162</u> <sup>93)</sup>	NP <u>A169</u> <sup>94)</sup>	Benzi <sup>2)</sup>	Adopted
0.00 5/2+	0.00 5/2+		0.00 5/2+	0.00 5/2+
0.1272 (3/2+)	0.1271 3/2+		0.127 3/2+	0.1271 3/2+
0.3067 (7/2+)	0.3067 7/2+		0.307 7/2+	0.3067 7/2+
0.3112 (5/2+)	0.3112 5/2+		0.311 5/2+	0.3112 5/2+
0.325 (1/2+)	0.3254 1/2+		0.325 1/2+	0.3254 1/2+
0.422	0.4224 3/2+		0.422 3/2+	0.4224 3/2+
0.52 (11/2-)	0.528 11/2-		0.52 11/2-	0.528 11/2-
0.5445 (9/2+)	0.5447 7/2+		0.545 7/2+	0.5447 7/2+
0.63	0.6161 (7/2+)		0.616 5/2+	0.6161 7/2+
0.64	0.6742 (3/2, 5/2+)		0.623 1/2+	0.6742 3/2+
	(0.6943)			(left out)
0.73	0.7200 (7/2, 9/2+)		0.72 7/2+	0.720 7/2+
0.85 0.842	0.8426 7/2+			0.8426 7/2+
	0.9111 (7/2, 9/2+)			0.9111 7/2+
	0.9282 (7/2, 9/2+)		0.929 9/2+	0.9282 9/2+
0.94	0.9381 7/2+			0.9381 7/2+
	1.0011 11/2+			1.0011 11/2+
	1.623 19/2-			
	1.861 15/2+			
	2.473 23/2-			

The 0.7200 MeV level has been assigned as 7/2+ from ( $\alpha, \alpha' \gamma$ ) data (O.C. Kistner and A. Schwarzschild, Phys. Rev. 154 (1967) 1182)<sup>95)</sup>, but the possibility of 9/2+ has been supported by reaction- $\gamma$  data (C. Lederer, J.M. Jaklevic and J.M. Hollander, Nucl. Phys. A169 (1971) 489)<sup>90)</sup>. For the 0.6742, 0.9111 and 0.9282 levels, no preferable reason exists to choose the one from the two possible spin values.

$^{102}_{44}\text{Ru}$ 

TIS <sup>82)</sup>		NDS(old)		NP Al55 <sup>96)</sup>		Benzi <sup>2)</sup>		Adopted	
0.00	0+	0.00	0+	0.00	0+	0.00	0+	0.00	0+
0.4748	2+	0.475	2+	0.4749	2+	0.475	2+	0.4749	2+
				0.9437	0+			0.9437	0+
1.103	2+	1.105	2+	1.1032	2+	1.105	2+	1.1032	2+
1.106	4+	1.105	4+	1.1066	4+	1.105	4+	1.1066	4+
1.53	3	1.525	(3+)	1.5219	3+	1.525	3+	1.5219	3+
				1.5808	2+			1.5808	2+
				1.7990	4+			1.7990	4+
1.84	0+	1.840	0+	1.8371	0+	1.84	0+	1.8371	0+
1.87	(4,5)	1.870	(2,3)	1.8732	6+	1.87	3+	1.8732	6+
2.04	2+	2.040	2+	2.0375	2+	2.04	2+	2.0375	2+
				2.0441	(3-)			2.0441	3-
2.22	(3)	2.220	3	2.2192	5+	2.22	3+	2.2192	5+
2.27		2.270		2.2613	2(+)			2.2613	2+
				2.372	5-			2.372	5-

Directional correlation measurements have given almost unique spin and parity assignments. However, following spin assignments cannot be excluded:  
 1.7990 3+, 1.8732 5+, 2.0441 4, and 2.2613 2-.

 $^{104}_{44}\text{Ru}$ 

TIS <sup>82)</sup>		NDS(old)		NP Al84 <sup>97)</sup>		Benzi <sup>2)</sup>		Adopted	
0.00	0+	0.00	0+	0.00	0+	0.00	0+	0.00	0+
0.3577	2+	0.358	2+	0.358	2+	0.358	2+	0.358	2+
0.89	2+	0.893	2+	0.889	2+	0.893	2+	0.889	2+
				0.893	4+			0.893	4+
				0.983	0+			0.983	0+
2.5				2.5					
3.5				3.5					
4.0				4.0					

No information is available for levels above 1 MeV.

 $^{106}_{44}\text{Ru}$ 

TIS <sup>82)</sup>		NP Al84 <sup>97)</sup>		Benzi <sup>2)</sup>		Adopted	
0.00	0+	0.00	0+	(none)		0.00	0+
		0.270	2+			0.270	2+
		0.711				0.711	4+
		0.791	2+			0.791	2+
		0.989	0+			0.989	0+
		1.772	(2+)			1.772	2+
		1.888	(2+)			1.888	2+
		1.906					
		2.151					
		2.367	(4+)				
		2.467					
		2.571					
		2.639	(0+)				
		2.771	(2+)				
		2.876					
		2.931					

Systematic trend suggests  
 4+ for the 0.711 MeV level.

$^{103}_{45}\text{Rh}$ 

TIS <sup>82)</sup>	PR C4 <sup>98)</sup> + NP A125 <sup>99)</sup>	Benzi <sup>2)</sup>	Adopted
0.00	1/2-	0.00	1/2-
0.04	7/2+	0.040	7/2+
0.093	(9/2+)	0.093	9/2+
0.298	3/2-	0.298	3/2-
0.360	5/2-	0.360	5/2-
0.537	(7/2+)	0.537	5/2+
0.6505	(7/2+)	0.651	7/2+
	0.798		0.798
	0.843	(3/2, 5/2-)	0.843
	0.877	(1/2, 3/2, 5/2, 7/2-)	0.877
	0.915	(5/2, 7/2, 9/2-)	0.915
	1.102	(5/2±, 7/2±, 9/2-)	1.102
	1.247	(5/2±, 7/2±, 9/2-)	1.247
	1.270		1.270
		0.798	5/2+
		0.843	3/2-
		0.877	5/2-
		0.915	5/2-
		1.102	7/2+
		1.247	9/2-
		1.270	1/2-

(many others up to 2.1 MeV)

The spins and parities for the levels up to 0.7 MeV may be uniquely determined from the data on  $^{103}\text{Ru}$  ground-state decay. The reaction data are available for higher levels, but so many discrepancies exist between existing experimental results.

After we finished this work, we found a paper on Coulomb excitation with fairly good accuracy which was not available before (R.O. Sayer, J.K. Temperley and D. Eccleshall, Nucl. Phys. A179 (1972) 122)<sup>100)</sup>. We cite the results of this paper below.

Level	NP A179 <sup>100)</sup>	
0.798	Not Coulomb excited but $(p, p')$	(0.8036) Weak evidence for the existence
0.843	B(E2), 3/2- is not definite	0.8477 (7/2)- Double Coulomb excitation
0.877	B(E2), ( $\alpha$ , $\alpha'$ ) suggest 5/2-	0.8804 5/2- from angular distribution of $\gamma$
0.915	B(E2), 5/2- is not definite	0.9200 (9/2)- Double Coulomb excitation
1.102	E3 excitation is probable	1.1072 (3/2, 5/2)- Weakly Coulomb excited
1.247	Possible double Coulomb excitation	-
1.270	Not Coulomb excited but $(p, p')$	1.2772 3/2- From $\gamma$ -intensities

 $^{105}_{46}\text{Pd}$ 

TIS <sup>82)</sup>	NDS(old)	Benzi <sup>2)</sup>	Adopted
0.00	5/2+	0.00	5/2+
0.2804	3/2+	0.281 (7/2+)	0.2804
0.3062	7/2+		0.3062
0.3191	(5/2)+	0.319	0.3191
0.3444	1/2+	0.345 (5/2+)	0.3444
0.4427	(5/2, 7/2)+	0.443 (3/2, 5/2+)	0.4427
0.4890	11/2-	0.503	0.4890
0.5607	(3/2+)		0.5607
0.6444	7/2-		0.6444
0.6506	(3/2)+	0.650	0.6506
0.6731		0.674 (5/2+)	0.6731
0.7271	(5/2+)		0.7271
0.78		0.785 (3/2+)	0.78
0.9623	+		0.9623
1.0015			1.0015
1.0878	3/2-	1.097 (3/2-)	1.0878
(a few others)			

For the spin assignments, the data of gamma transition are carefully checked. The possible relocation of gammas are also considered.

$^{107}_{46}\text{Pd}$ TIS<sup>82)</sup>NDS B7<sup>101)</sup>Benzi<sup>2)</sup>

Adopted

0.00	5/2+	0.00	5/2+	(none)	0.00	5/2+
0.115	(1/2)+	0.1157	1/2+		0.1157	1/2+
0.21	11/2-	0.214	(11/2)-		0.214	11/2-
		0.3028	(3/2, 5/2)+		0.3028	5/2+
0.307	(7/2)+	0.3122	(7/2, 9/2)+		0.3122	7/2+
		0.3482			0.3482	3/2+
		0.366	(7/2, 9/2)+		0.366	9/2+
		0.3819	(3/2, 5/2)+		0.3819	3/2+
0.39	(3/2)+	0.3924			0.3924	7/2+
		0.412	1/2+		0.412	1/2+
0.47	(3/2)+	0.4712	(3/2, 5/2)+		0.4712	3/2+
0.57	(5/2)+	0.5677	(3/2, 5/2)+		0.5677	5/2+
0.67	(7/2)+	0.6701	(3/2, 5/2)+		0.6701	5/2+
		0.685			0.685	7/2-
0.70	(1/2)+	0.698	1/2+		0.698	1/2+
0.77	(3/2)+	0.759	(3/2, 5/2)+		0.759	3/2+
		0.781	(1/2, 3/2)-		0.781	3/2-
0.80		0.806			0.806	1/2-
0.89	(1/2)+	0.889	1/2+		0.889	1/2+
0.99	(11/2)-					
1.03	(3/2)+	1.023	(3/2, 5/2)+		1.023	5/2+
1.08	(5/2)+	1.071	(3/2, 5/2)+			
		(many other levels)				

Spins and parities for many levels have been determined tentatively by looking at and checking again the all data on beta and gamma transitions and on (d,p) reaction, cited in NDS B7.<sup>101)</sup>

 $^{109}_{47}\text{Ag}$ TIS<sup>82)</sup>NDS B6<sup>102)</sup>Benzi<sup>2)</sup>

Adopted

0.00	1/2-	0.00	1/2-	0.00	1/2-	
0.0877	7/2+	0.088032	7/2+	0.088032	7/2+	
0.129		0.1328	(9/2)+	0.1328	9/2+	
0.309	3/2-	0.3114	3/2-	0.3114	3/2-	
0.414	5/2-	0.4153	5/2-	0.4153	5/2-	
		0.7019	3/2-	0.7019	3/2-	
0.72		0.7244	(3/2+)	0.7244	3/2+	
0.73		0.7353	(5/2+)	0.7353	5/2+	
		0.8398		0.8398	7/2-	
0.86		0.8627	5/2-	0.8627	5/2-	
		0.8695	(5/2+)	0.8695	5/2+	
		0.9110		0.9110	7/2-	
		0.9123		0.9123	3/2+	
		1.0906		1.092	3/2-	
		1.099				
		1.26				
		1.3242	(3/2-)	1.322	3/2--	
		(a few more levels)				

Rather tentative assignments for the 0.8398, 0.9110 and 0.9123 MeV levels are based on the decay data used in NDS B6.<sup>102)</sup>

<sup>129</sup>  
<sup>53</sup>

TIS <sup>82)</sup>	NDS	B8 <sup>103)</sup>	Benzi <sup>2)</sup>	Adopted
0.00	7/2+	0.00	7/2+	0.00
0.0278	5/2+	0.02777	5/2+	0.02777
0.278		0.27842	(3/2,5/2)+	0.27842
0.487	(3/2+)	0.48738	(3/2,5/2)+	0.48738
0.557		0.55957	1/2+	0.55957
0.697		0.69598		0.69598
0.730		0.72962		0.72962
		0.7689		0.7689
0.831		0.8299		0.8299
0.846		0.8450		0.8450
1.022		1.0504		1.0504
1.077		1.052	(3/2,5/2)+	1.052
1.083				
1.112		1.11175	(3/2,5/2)+	1.11175
		(1.2042?)		(left out)
		1.210	1/2+	1.210
1.262		1.2608	(3/2,5/2)+	1.2608
		1.2821		1.2821
		1.2922		1.2922
1.378				
1.404		1.4016	(9/2)+	1.4016
		(many other levels)		9/2+

The present spin and parity assignments have been done based on the beta and gamma data listed in NDS B8.103). These are rather tentative but not inconsistent with the existing experimental data.

<sup>131</sup>  
<sup>54</sup>Xe

TIS <sup>82)</sup>	NDS(old)	Benzi <sup>2)</sup>	Adopted
0.00	3/2+	0.00	3/2+
0.08016	1/2+	0.0802	(1/2)+
0.16398	11/2-	0.1639	11/2-
0.17723 or		0.150 or	
0.32578	+	0.210	0.32578
0.36447	5/2+	0.364	5/2+
0.5030	+	(0.54)	0.5030
0.6370	(5/2+)	0.638	(5/2+)
0.7229		0.724	(5/2,7/2+)
			0.7229
		0.724	3/2-

The position of a level at 0.32578 MeV is not definitive but tentative.

The parity of the 0.5030 MeV level cannot be assigned if the decay scheme illustrated on TIS82) is acceptable. Because, log ft of a beta to the 0.5030 MeV level (8.4) suggests it is first forbidden giving the negative parity although the conversion coefficients of transitions from the 0.5030 MeV level indicate positive parity of this level (The 0.5030 MeV  $\gamma$  to the 3/2+ ground state is possibly E2, and a cascade, 0.17723 MeV  $\gamma$  (E2) + 0.32578 MeV  $\gamma$  (M1 + E2), to the ground state also exists.). Even if the intensity of the beta to the 0.5030 MeV level is assumed to be 5% instead of 0.5%, the log ft value seems to be still high.

$^{133}\text{Cs}$ 

TIS <sup>82)</sup>	NDS(old)	NP A171 <sup>104)</sup>	Benzi <sup>2)</sup>	Adopted
0.00	7/2+	0.00 7/2+	0.00 7/2+	0.00 7/2+
0.081	5/2+	0.081 5/2+	0.081 5/2+	0.0810 5/2+
0.1605	5/2+	0.160 (3/2)+	0.1605 5/2+	0.1605 5/2+
0.382	3/2+	0.382 (3/2)+	0.3828 3/2+	0.3828 3/2+
0.437	1/2+	0.436 1/2(+)	0.4371 1/2+	0.4371 1/2+
		0.605 11/2-		0.605 11/2-
		0.633 11/2+		0.633 11/2+
		0.641 3/2+		0.641 3/2+
		0.706 (7/2, 9/2+)		0.706 7/2+
		0.768 (7/2, 9/2+)		0.768 9/2+
		0.787 (7/2, 9/2+)		0.787 7/2+
		0.819 (5/2, 7/2, 9/2+)	0.819	0.819 7/2+
		0.873 (7/2, 9/2+)		0.873 9/2+
		0.917 (3/2, 5/2+)		0.917 3/2+

No preferable argument at all for selecting the spin value for the levels higher than 0.7 MeV.

 $^{135}\text{Cs}$ 

TIS <sup>82)</sup>	NDS(old)	NP A121 <sup>105)</sup>	Benzi <sup>2)</sup>	Adopted
0.00	7/2+	0.00 7/2+	0.00 7/2+	0.00 7/2+
0.25	(5/2+)	0.25 (5/2)+	0.2498 (5/2+)	0.2498 5/2+
		0.4082		0.4082 3/2+
0.61		0.604 (3/2, 5/2)	0.6086 (3/2, 5/2)	0.6086 5/2+
0.781	(11/2+)		(0.780)	0.780 11/2+
		0.9817		0.9817 1/2+
		1.0626		1.0626 3/2+

1.621 (19/2-)

Spin and parity assignments for the levels at 0.4082, 0.6086 and 0.78 MeV are based on systematic trend, for instance discussed in Phys. Rev. C5 (1972) 1759<sup>106</sup>). The 0.9817 and 1.0626 MeV levels are assigned by using the beta and gamma data.

 $^{137}\text{Cs}$ 

TIS <sup>82)</sup>	PR C3	Benzi	Adopted
0.00	7/2+	0.00 7/2+	0.00 7/2+
0.455		0.455 5/2+	0.455 5/2+
	(0.85)		0.85 3/2+
	(0.98)		0.98 5/2+
	1.49	1/2+	1.49 1/2+
	1.87	11/2-	1.87 11/2-
	2.07	3/2+	2.07 3/2+
	2.15	1/2+	2.15 1/2+

The 0.85 and 0.98 MeV levels which have been cited in Phys. Rev. C5 (1972) 1759<sup>106</sup>) are assigned by using the systematic trend.

$^{144}_{58}\text{Ce}$ 

TIS <sup>82)</sup>		NDS <u>B2</u> <sup>108)</sup>		PRL <u>25</u> <sup>109)</sup>		Benzi <sup>2)</sup>		Adopted	
0.00	0+	0.00	0+	0.00	0+	(none)		0.00	0+
				0.3975	2+			0.3975	2+
								0.80	4+

The 4+ level at 0.8 MeV has been estimated from systematics.

 $^{143}_{60}\text{Nd}$ 

TIS <sup>82)</sup>		NDS <u>B2</u> <sup>110)</sup>		Benzi <sup>2)</sup>		Adopted	
0.00	7/2-	0.00	7/2-	0.00	7/2-	0.00	7/2-
0.742	(9/2--)	0.742	3/2-	0.745	9/2-	0.742	3/2-
		1.236	(9/2,11/2)-			1.236	9/2-
		1.311	(1/2,3/2)-			1.311	1/2-
		1.412	(9/2,11/2)- or (7/2 to 13/2)+			1.412	13/2+
		1.560	(5/2,7/2)-			1.560	5/2-
		1.743	(9/2,11/2)-			1.743	7/2-
		1.857	(1/2,3/2)-			1.857	3/2-
		1.916	(5/2,7/2)-			1.916	7/2-
		2.016				2.016	7/2+
		2.131	(1/2,3/2)-			2.131	1/2-
		2.192	(5/2,7/2)-			2.192	5/2-
		2.261	(1/2,3/2)-			2.261	3/2-
		2.328	(1/2,3/2)-			2.328	3/2-
		2.367	(1/2,3/2)-			2.367	1/2-

Since this contains 83 neutrons, possible single particle levels and some kinds of systematics have been considered. However, present assignments are still tentative.

 $^{144}_{60}\text{Nd}$ 

TIS <sup>82)</sup>		NDS <u>B2</u> <sup>108)</sup>		NDS <u>B2</u> <sup>108)</sup> NP <u>A185</u> <sup>111)</sup>		Benzi <sup>2)</sup>		Adopted	
0.00	0+	0.00	0+	0.00	0+	0.00	0+	0.00	0+
0.695	2+	0.6964	2+	0.6964	2+	0.696	2+	0.6964	2+
1.310	4+	1.3145	4+	1.3145	4+	1.313	4+	1.3145	4+
1.51	(3-)	1.5099	(3-)	1.5099	3-			1.5099	3-
1.56		1.5600	2(+)	1.5600	2+	1.556	3+	1.5600	2+
		1.738		1.738				1.738	2+
1.784	6+	1.7902	6+	1.7902	6+	1.78	0+	1.7902	6+
2.10		2.085		2.085	0+			2.085	0+
		2.09							
		2.111		2.11				2.11	2-
2.184	1(-)	2.1856	1-	2.1856	1-	2.18	1-	2.1856	1-
		2.20							
		2.287	(4+)	2.287	4+			2.287	4+
2.36		2.37	(2+)	2.37	2+			2.37	2+
		(many other levels)				2.86	1-		

No beta and electron capture transitions and gamma transition data suggest 2+ and 2- for the 1.738 and 2.11 MeV levels, respectively.

$^{145}_{60}\text{Nd}$ 

TIS <sup>82)</sup>	NDS B2 <sup>112)</sup>	Benzi <sup>2)</sup>	Adopted
0.00    7/2-	0.00    7/2-	0.00    7/2-	0.00    7/2-
0.067   (3/2)-	0.067   (3/2)-	0.067   7/2-	0.067   3/2-
0.072   (5/2)-	0.072   (5/2)-	0.072   3/2-	0.072   5/2-
0.75	0.749	0.74	0.749
0.92	0.92	0.92	0.92
1.05	1.054	1.05	1.054
1.16	1.155	1.16	1.155
1.39	1.39	1.39	1.39

The spin and parity assignments for the levels above 0.7 MeV are based on the data on beta and gamma transitions. These levels are Coulomb excited except for a level at 1.155 MeV.

 $^{147}_{61}\text{Pm}$ 

TIS <sup>82)</sup>	NDS B2 <sup>113)</sup>	Benzi <sup>2)</sup>	Adopted
0.00    7/2+	0.00    7/2+	(none)	0.00    7/2+
0.09106   5/2+	0.0911   5/2+		0.0911   5/2+
0.4105   3/2+	0.4105   (3/2+)		0.4105   3/2+
0.4892   (7/2+)	0.4893   (5/2, 7/2)+		0.4893   7/2+
0.5309   5/2+	0.5310   5/2(+)		0.5310   5/2+
	0.6804		0.6804   3/2+
0.6858   5/2+	0.6859   (5/2+)		0.6859   5/2+
0.72			

No preferable reason exists for selecting 7/2+ to the 0.4893 MeV level and 3/2+ to the 0.6804 MeV level (3/2, 5/2, 7/2+).

 $^{147}_{62}\text{Sm}$ 

TIS <sup>82)</sup>	NDS B2 <sup>113)</sup>	Benzi <sup>2)</sup>	Adopted
0.00    7/2-	0.00    7/2-	0.00    7/2-	0.00    7/2-
0.1218   5/2-	0.1212   (5/2)-	0.121   5/2-	0.1212   5/2-
0.1981   3/2-	0.1974   (3/2)-	0.197   3/2-	0.1974   3/2-
0.71	0.713	0.71	0.713
0.80    (3/2, 5/2-)	0.7988   (3/2-)	0.80    3/2-	0.7988   3/2-
	0.808		0.808   13/2+
0.90		0.90    5/2-	
0.92	0.925	0.92    3/2-	0.925   11/2+
	1.007   (1/2-)		1.007   1/2-
1.02	1.029	1.02    5/2+	1.029   11/2+
1.06    (3/2, 5/2+)	1.054   (5/2)+	1.06    3/2-	1.054   5/2+
	1.065   (5/2)+		1.065   5/2+
1.079	1.077   (5/2, 7/2-)	1.079   7/2-	1.077   7/2-
1.10	1.103	1.10    3/2-	1.103   9/2-
1.16	1.166	1.16    5/2-	1.166   11/2-
	1.180		1.180   7/2-

(many other levels)

High spins are assigned for several levels which are not fed by the decay of the 5/2+ ground state of Eu-147 but by Coulomb excitation and other reaction processes.

$^{149}_{62}\text{Sm}$ 

TIS <sup>82)</sup>	NDS(old)	Benzi <sup>2)</sup>	Adopted
0.00	7/2-	0.00	7/2-
0.0225	5/2-	0.022	0.0225
0.2772		0.277	0.2772
0.2857	(5/2-)	0.286	0.2857
0.3502		0.350	0.3502
0.398		0.398	0.398
0.5286		0.529	0.5286
0.5583		0.558	0.5583
0.566		0.582	0.566
0.640	0.650		0.640
(a few more levels)			

The present spin and parity assignments are based on data for beta, electron capture, and gamma transitions cited in TIS<sup>82</sup>). The 0.2857 MeV level is assigned as 9/2- instead of 5/2- since the 0.2857 MeV is not fed by decay of the ground state of Eu-149 (5/2+) but of Pm-149 (7/2+).

 $^{151}_{62}\text{Sn}$ 

TIS <sup>82)</sup>	NP A172 <sup>114)</sup>	Benzi <sup>2)</sup>	Adopted
0.00	(5/2-, 7/2-)	0.00	(5/2)-
0.00482	( - )	0.00482	(7/2)-
0.06583	( - )	0.06582	(3/2)-
0.06969	( - )	0.0697	(5/2, 7/2)-
0.09153	( + )	0.09153	(1/2)+
0.10482	( - )	0.10485	(5/2)-
0.16773	( + )	0.16772	(5/2)+
0.16838	( - )	0.16839	(5/2, 7/2)-
0.20899	( - )	0.20898	(7/2)-
0.307		0.3067	(3/2)-
0.32392	( + )	0.3239	(3/2)+
0.34489	( + )	0.34487	(7/2)+
(many others)			

Selection of 5/2- and 7/2- for the 0.0697 and 0.16839 MeV levels, respectively, is rather arbitrary.

$^{153}_{63}\text{Eu}$ 

TIS <sup>82)</sup>	NDS(old)	Benzi <sup>2)</sup>	Adopted
0.00 5/2+	0.00 5/2+	0.00 5/2+	0.00 5/2+
0.08337 7/2+	0.084 (7/2+)	0.0830 7/2+	0.08337 7/2+
0.09743 5/2-	0.097 (5/2-)	0.0970 5/2-	0.09743 5/2-
0.103179 3/2+	0.103 (3/2+)	0.1030 3/2+	0.10318 3/2+
0.15161 7/2-		0.1520 7/2-	0.15161 7/2-
0.172854 5/2+	0.173 (5/2+)	0.1730 5/2+	0.17285 5/2+
0.1914 9/2+	0.191 (9/2+)		0.1914 9/2+
0.268		0.2700 7/2+	0.268 7/2+
0.6346 (1/2+)		0.6350 3/2+	0.6346 1/2-
0.6364 (3/2+)			0.6364 3/2-
0.682		0.6820 5/2+	0.682 5/2-
0.6943		0.6940 3/2+	0.6943 1/2-
0.7064	0.70 (1/2+)	0.7070 5/2-	0.7064 3/2-

The spin and parity assignments for the levels above 0.2 MeV are based on betas and gammas illustrated in TIS<sup>82)</sup>. Log ft values calculated for betas to the levels above 0.6 MeV seem to be too high for allowed transitions.

 $^{155}_{63}\text{Eu}$ 

TIS <sup>82)</sup>	NDS(old)	Benzi <sup>2)</sup>	Adopted
0.00 (5/2+)	0.00 (5/2+)	(none)	0.00 5/2+
0.075 (7/2+)			0.075 7/2+
0.10435 (5/2-)	0.1044 (5/2-)		0.10435 5/2-
0.17 (7/2-)			0.17 7/2-
0.2462 (3/2+)	0.246 (3/2+)		0.2462 3/2+
0.31 (5/2+)			0.31 5/2+
0.76			0.76 1/2-
0.87			0.87 5/2+
1.09			1.09 3/2+
1.27			1.27 5/2-

The spins and parities for the levels above 0.7 MeV are assigned by looking at the data on beta and gamma transitions listed in TIS<sup>82)</sup>.

#### 4.2 Average Resonance Parameters and Others

The calculations of neutron capture cross section for the important 28 FP nuclides were performed using RACY code<sup>17)</sup> based on the process of compound nucleus formation. In this code, the neutron separation energy  $B_n$  and level parameter  $\xi^*$ , which is obtained through the radiation width and level spacing, are required as the input data, as well as the level density parameters. On the other hand, the inelastic scattering cross sections were calculated by ELIESE-3 code<sup>16)</sup> based on the optical model and Hauser-Feshbach's theory<sup>7)</sup>. In this calculation, the level density parameters are the important input data, when the incident energy is larger than the energy  $E_x$  mentioned in section 2. In this sub-section, description of the criteria or method of determination of these quantities (input data) is given.

##### 1) Radiation Width

The experimental data on radiation width  $\Gamma_\gamma$  have been obtained by many authors, but the agreement between these data is not so well. It is very difficult to find out the most reliable values from among these data. Therefore, in the present work, the values of radiation width  $\Gamma_\gamma$  for the important 28 nuclides were determined in principle on the basis of the data cited in BNL-325, 2nd Edition, Supplement No. 2<sup>11)</sup>. However, the method of determination is not the same for each nuclide.

- A) The following methods were used for nuclides whose recommended values of radiation width  $\Gamma_\gamma$  are given in Ref. 11.
  - i) The averaged values of the recommended values for each level were adopted for Rh-103, Pd-105, Ag-109, Cs-133, Nd-143, Nd-145, Sm-147, Sm-149, and Eu-153.
  - ii) The assumed values cited in Ref. 11 were adopted for Mo-95 and Mo-97 on the basis of those for  $\Gamma_\gamma$  of the neighboring isotopes of Mo, although the recommended values for a few levels are given for both nuclides. Where, the assumed values mean values enclosed in parentheses in Ref. 11, and are values which the experimenter assumed in order to compute other resonance parameters.
  - iii) The guessed values taking into account of the systematic trends for  $\Gamma_\gamma$  of the neighboring nuclides were adopted for Ru-101 and Ru-102, although the recommended values for a few levels are given for both nuclides.
- B) The following methods were used for nuclides whose recommended values are not given.

- i) The assumed value cited in Ref. 11 was adopted for  $^{129}\text{I}$ .
- ii) The values guessed on the basis of the assumed values for the neighboring isotopes were adopted for  $^{90}\text{Sr}$  and  $^{93}\text{Zr}$ .
- iii) The guessed values taking into account of the systematic trends for  $\Gamma_\gamma$  of the neighboring nuclides were adopted for  $^{104}\text{Ru}$ ,  $^{107}\text{Pd}$ ,  $^{135}\text{Cs}$ ,  $^{137}\text{Cs}$ ,  $^{144}\text{Ce}$ ,  $^{144}\text{Nd}$ ,  $^{151}\text{Sm}$ ,  $^{155}\text{Sm}$ .
- iv) The data evaluated by other authors were adopted for  $^{99}\text{Tc}$ ,  $^{106}\text{Ru}$ ,  $^{131}\text{Xe}$ , and  $^{147}\text{Pm}$ .  
(the data of Garrison and Roos<sup>14)</sup> for  $^{99}\text{Tc}$  and  $^{147}\text{Pm}$ , and of Benzi and Reffo<sup>2)</sup> for  $^{106}\text{Ru}$  and  $^{131}\text{Xe}$ )

The final result obtained here is shown in Table 4.2.1 with other reference data on the radiation width.

## 2) Level spacing

The level spacing  $D$  of the compound nucleus is an important parameter for the calculation of the neutron capture cross section. However, the accuracy and number of the experimental data are not necessarily satisfactory. In the early stage of this work, the values of level spacing were taken from the report of Baba<sup>13)</sup>. For the nuclei of which the level spacing is not measured, the values of the level spacing were estimated on the basis of neutron number and mass number dependence of the level spacing.

Using the values of the level spacing and the radiation width, the level parameter  $\xi^0$  was obtained for each nucleus. The level parameter  $\xi^0$  is given by the following formula.

$$\xi^0 = \frac{2I+1}{\pi} \frac{D_{\text{obs}}}{\Gamma_\gamma}, \quad (4.2.1)$$

where  $I$  is the spin of target nucleus.

Results of the neutron capture cross section calculated by using RACY code were compared with the experimental data in the energy range from 1 keV to 15 MeV. For some nuclei whose neutron capture cross sections are not measured, comparison was performed for the (capture) cross section between the present results and the evaluated data of Cook<sup>5)</sup>, and Benzi and Reffo<sup>2)</sup>. Result of this comparison showed that better agreement was not obtained between the present results and the experimental data for the most of nuclides. Therefore, adjustment of the level parameter  $\xi^0$  was made through modification of the level spacing  $D$ , in order to get good agreement with the experimental data. Result of this adjustment suggested that, for some nuclides, two values of the level parameter were necessary in separate

energy range for the same nucleus. The nuclides which need two values of the level parameter are  $^{95}\text{Mo}$ ,  $^{97}\text{Mo}$ ,  $^{102}\text{Ru}$ , and  $^{153}\text{Eu}$ . For  $^{95}\text{Mo}$ , good agreement of the calculated capture cross section with the experimental data was obtained by using the following two values, 138.7 eV for  $E_n < 0.2$  MeV, and 100 eV for  $E_n \leq 0.2$  MeV.

As a result of these investigations, the values of level spacing D and level parameter  $\xi^0$  were modified for 15 nuclides. The initial and final values of these parameters are shown in Table 4.2.2 and Table 4.2.3.

### 3) Neutron separation energy

The neutron separation energy  $B_n$  is necessary as one of the input data for the RACY code. The data on neutron separation energy or nuclear mass are published by many authors. In this work, the neutron separation energy of each nucleus was obtained using the data of Mattauch, Thiele, and Wapstra<sup>117)</sup> cited in "Table of Isotopes, 6th Edition, 1968<sup>82)</sup>". The values of neutron separation energy for the important 28 nuclides are shown in Table 4.2.3.

### 4) Level density formula

The level density formula used in this work is given as follows.

$$\rho(U, I) = \rho_G(U, I) = \frac{2I+1}{C_0 U^2} e^{2\sqrt{aU}} \cdot e^{-I(I+1)/2\sigma^2} \quad \text{for } E \geq E_c, \quad (4.2.2)$$

$$\rho(U, I) = \rho_T(U, I) = \rho_G(U_0, I) e^{(U-U_0)/T} \quad \text{for } E < E_c, \quad (4.2.3)$$

where,  $U \equiv E - A$ ,

$I$  = spin of target nucleus,

$a$  = level density parameter,

$\sigma$  = spin cut off factor,

$T$  = nuclear temperature,

$E_c$  = energy of tangency point,

$E$  = total excitation energy,

$C_0 \equiv 24\sqrt{2} (0.0888)^{3/2} A a$ .

The spin cut off factor  $\sigma$  is calculated using a formula which is built in ELIESE-3 code. Using this formula, the value of  $\sigma^2$  is 1.5 ~ 2.5 times as large as that obtained using the formula of Gilbert and Cameron<sup>15)</sup>. The value of level density obtained by ELIESE-3 code is larger than that obtained by the formula of Gilbert and Cameron, owing to the difference between the spin terms of both formula. Since they adopted  $e^{-(I+\frac{1}{2})^2}$  as the spin term,

this difference decreases with increasing values of spin I for the target nucleus. The level density parameters used in the formulas (4.2.2) and (4.2.3) are given for the target and compound nuclei in Table 4.2.4.

Table 4.2.1 Gamma Width  $\Gamma_r$  (meV)

Nuclide	Present Work	Benzi & Reffo <sup>2)</sup>	Garrison <sup>14)</sup> and Ross	Musgrove <sup>118)</sup>
<sup>90</sup> Sr	205	—	—	147
<sup>93</sup> Zr	300	—	—	176
<sup>95</sup> Mo	260	205	260	227
<sup>97</sup> Mo	260	190	260	200
<sup>99</sup> Tc	180	—	180	170
<sup>101</sup> Ru	180	160	240	191
<sup>102</sup> Ru	200	170	200	186
<sup>103</sup> Rh	160	195	180	111
<sup>104</sup> Ru	200	150	—	210
<sup>105</sup> Pd	155	150	160	155
<sup>106</sup> Ru	150	150	—	186
<sup>107</sup> Pd	140	—	—	135
<sup>109</sup> Ag	130	130	130	157
<sup>129</sup> I	100	—	—	96.2
<sup>131</sup> Xe	110	110	85	178
<sup>133</sup> Cs	125	125	110	128
<sup>135</sup> Cs	125	—	—	287
<sup>137</sup> Cs	100	—	—	171
<sup>143</sup> Nd	95	70	90	88.4
<sup>144</sup> Ce	90	—	—	59.4
<sup>144</sup> Nd	80	70	—	87.2
<sup>145</sup> Nd	80	65	50	78.2
<sup>147</sup> Pm	80	—	80	70.4
<sup>147</sup> Sm	50	95	60	65.8
<sup>149</sup> Sm	65	95	60	52.4
<sup>151</sup> Sm	65	—	62	36.3
<sup>153</sup> Eu	100	95	90	129
<sup>155</sup> Eu	100	—	—	129

Table 4.2.2 Level Spacing (eV)

nuclide	I	2I+1	Present Work		Benzi & Reffo 2) cook	115)116) Garrison & Roos 14)	Musgrave 118)
			1st guess	final value			
<sup>90</sup> Sr <sub>38</sub>	0 <sup>+</sup>	1	4000	12000	—	850 5400	10000
<sup>93</sup> Zr <sub>40</sub>	5 <sup>+</sup> 2	6	150	300	—	500	400
<sup>95</sup> Mo <sub>42</sub>	5 <sup>+</sup> 2	6	100	{100 ( $E > 0.2 \text{ MeV}$ ) 138.7 ( $E < 0.2 \text{ MeV}$ )}	94.92	200	150
<sup>97</sup> Mo <sub>42</sub>	5 <sup>+</sup> 2	6	120	{120 ( $E > 0.1 \text{ MeV}$ ) 144.8 ( $E < 0.1 \text{ MeV}$ )}	74.94	240	150
<sup>99</sup> Tc <sub>43</sub>	9 <sup>+</sup> 2	10	26	26	—	24	19
<sup>101</sup> Ru <sub>44</sub>	5 <sup>+</sup> 2	6	15	15	17.00	14	26
<sup>102</sup> Ru <sub>44</sub>	0 <sup>+</sup>	1	250	{250 ( $E > 0.2 \text{ MeV}$ ) 625 ( $E < 0.2 \text{ MeV}$ )}	229.0	630	300
<sup>103</sup> Rh <sub>45</sub>	1 <sup>-</sup> 2	2	10.3	30.9	32.95	26	35
<sup>104</sup> Ru <sub>44</sub>	0 <sup>+</sup>	1	250	942.5	662.4	78 740	600
<sup>105</sup> Pd <sub>46</sub>	5 <sup>+</sup> 2	6	11.1	11.1	9.551	15	14
<sup>106</sup> Ru <sub>44</sub>	0 <sup>+</sup>	1	250	1000	—	—	1310
<sup>107</sup> Pd <sub>46</sub>	5 <sup>+</sup> 2	6	10	10	—	34 14	20
<sup>109</sup> Ag <sub>47</sub>	1 <sup>-</sup> 2	2	19.1	19.1	18.79	16	18
<sup>127</sup> I <sub>53</sub>	5 <sup>+</sup> 2	6	19	19	12.98	13	14
<sup>129</sup> I <sub>53</sub>	7 <sup>+</sup> 2	8	21	21	—	19	20
<sup>131</sup> Xe <sub>54</sub>	3 <sup>+</sup> 2	4	32	32	33.76	25	30
<sup>133</sup> Cs <sub>55</sub>	7 <sup>+</sup> 2	8	20.7	24.8	21.71	19	20
<sup>135</sup> Cs <sub>55</sub>	7 <sup>+</sup> 2	8	60	60	—	70 140	90
<sup>137</sup> Cs <sub>55</sub>	7 <sup>+</sup> 2	8	150	1100	—	8000 860	1300
							1930

nuclide	I	2I+l	Present Work		Benzi <sup>2)</sup> & Reffo	115)116) cook	Garrison <sup>14)</sup> & Roos	Musgrove <sup>118)</sup>
			1st guess	final value				
<sup>139</sup> La <sub>57</sub>	$\frac{7}{2}^+$	8	110	110	483.6	430	800	257
<sup>140</sup> Ce <sub>50</sub>	$0^+$	1	3000	3000	3000.0	6000 2300	7000	3030
<sup>141</sup> Pr <sub>59</sub>	$\frac{5}{2}^+$	6	83.8	83.8	113.9	110	100	75.5
<sup>143</sup> Nd <sub>60</sub>	$\frac{7}{2}^-$	8	19	40	34.3	38	40	27.9
<sup>144</sup> Ce <sub>58</sub>	$0^+$	1	300	1000	—	—	—	98.1
<sup>144</sup> Nd <sub>60</sub>	$0^+$	1	600	600	676.8	280 86	500	225
<sup>145</sup> Nd <sub>60</sub>	$\frac{7}{2}^-$	8	25	25	24.14	23	25	24.3
<sup>147</sup> Pm <sub>61</sub>	$\frac{7}{2}^+$	8	5.7	5.7	—	3.1	2.1	3.73
<sup>147</sup> Sm <sub>62</sub>	$\frac{7}{2}^-$	8	7.9	4.0	6.538	7.5	6	3.96
<sup>149</sup> Sm <sub>62</sub>	$\frac{7}{2}^-$	8	3.2	3.2	3.069	2.7	2.2	1.67
<sup>151</sup> Sm <sub>62</sub>	$\frac{5}{2}^-$	6	1.3	1.3	—	1.3	0.75	0.199
<sup>153</sup> Eu <sub>63</sub>	$\frac{5}{2}^-$	6	1.3	1.3(E>0.1MeV) 2.6(E<0.1MeV)	0.9985	1.00	0.7	0.915
<sup>155</sup> Eu <sub>63</sub>	$\frac{5}{2}^+$	6	2.5	2.5	—	2.5 2.1	—	1.03

Table 4.2.3 Neutron Separation Energy  $B_n$  and  $\xi^0$ 

Nuclide	$B_n$ (MeV)	$\xi^0$		Nuclide	$B_n$ (MeV)	$\xi^0$	
		initial guess	final value			initial guess	final value
$^{90}\text{Sr}$	5.801	6210.92	18633	$^{131}\text{Xe}$	8.932	370.40	370.40
$^{93}\text{Zr}$	8.228	954.93	1909.86	$^{133}\text{Cs}$	6.701	421.70	506.00
$^{95}\text{Mo}$	9.156	734.56	734.56 ( $E_n > 0.2\text{ MeV}$ ) 1019.0 ( $E_n < 0.2\text{ MeV}$ )	$^{135}\text{Cs}$	6.871	1222.31	1222.31
$^{97}\text{Mo}$	8.642	881.47	881.47 ( $E_n > 0.1\text{ MeV}$ ) 1064.0 ( $E_n < 0.1\text{ MeV}$ )	$^{137}\text{Cs}$	4.871	3819.72	28010.0
$^{99}\text{Tc}$	6.641	459.78	459.78	$^{143}\text{Nd}$	7.831	509.30	1072
$^{101}\text{Ru}$	9.216	156.16	159.16	$^{144}\text{Ce}$	4.581	1061.03	3530
$^{102}\text{Ru}$	6.243	397.89	397.89 ( $E_n > 0.2\text{ MeV}$ ) 994.70 ( $E_n < 0.2\text{ MeV}$ )	$^{144}\text{Nd}$	5.741	2387.32	2387.32
$^{103}\text{Rh}$	7.007	40.982	123.0	$^{145}\text{Nd}$	7.561	795.77	795.77
$^{104}\text{Ru}$	5.981	397.89	1500.0	$^{147}\text{Pm}$	5.881	181.44	181.44
$^{105}\text{Pd}$	9.551	136.77	136.77	$^{147}\text{Sm}$	8.141	402.34	202.30
$^{106}\text{Ru}$	5.441	530.52	2122.08	$^{149}\text{Sm}$	7.981	125.37	125.37
$^{107}\text{Pd}$	9.223	136.42	136.42	$^{151}\text{Sm}$	8.231	38.197	38.197
$^{109}\text{Ag}$	6.824	93.534	93.534	$^{153}\text{Eu}$	6.391	24.838	24.828 ( $E_n > 0.1\text{ MeV}$ ) 49.66 ( $E_n < 0.1\text{ MeV}$ )
$^{129}\text{I}$	6.461	534.76	534.76	$^{155}\text{Eu}$	6.331	47.746	47.746

Table 4.2.4 Level density parameters

	$a(\text{MeV}^{-1})$	$\Delta (\text{MeV})$	$C_0 (\text{MeV}^{-1})$	$E_c (\text{MeV})$
Sr-90	10.552	1.960	852.9	6.127
-91	11.245	1.240	919.0	5.388
Zr-93	11.381	1.200	950.6	5.313
-94	12.158	2.320	1026.0	6.416
Mo-95	11.364	1.280	969.7	5.359
-96	12.153	2.400	1048.0	6.463
Mo-97	12.929	1.280	1126.0	5.326
-98	13.548	2.570	1192.0	6.601
Tc-99	13.541	1.290	1186.0	5.305
-100	13.971	0.0	1255.0	4.000
Ru-101	13.925	1.280	1263.0	5.265
-102	14.643	2.220	1341.0	6.191
Ru-102	14.643	2.220	1341.0	6.161
-103	15.249	1.280	1411.0	5.236
Rh-103	14.692	0.940	1359.0	4.896
-104	15.302	0.0	1429.0	3.942
Ru-104	16.008	2.520	1495.0	6.462
-105	16.643	1.280	1570.0	5.209
Pd-105	15.160	1.350	1430.0	5.279
-106	15.927	2.590	1516.0	6.505
Ru-106	17.084	2.530	1626.0	6.445
-107	17.461	1.280	1678.0	5.182
Pd-107	16.568	1.350	1592.0	5.252
-108	17.010	2.600	1650.0	6.489
Ag-109	16.797	1.250	1644.0	5.126
-110	17.173	0.0	1697.0	3.864
I-129	15.869	1.200	1839.0	4.863
-130	14.991	0.0	1750.0	3.654
Xe-131	16.139	1.120	1899.0	4.765
-132	14.967	2.160	1774.0	5.796

	$a$ (MeV $^{-1}$ )	$A$ (MeV)	$c_0$ (MeV $^{-1}$ )	$E_c$ (MeV)
Cs-133 -134	16.130	1.040	1927.0	4.668
	14.850	0.0	1787.0	3.619
Cs-135 -136	13.550	0.700	1643.0	4.311
	12.353	0.0	1509.0	3.603
Cs-137 -138	11.175	0.850	1375.0	4.445
	12.408	0.0	1538.0	3.587
Nd-143 -144	18.195	1.180	2337.0	4.729
	19.167	1.940	2479.0	5.482
Ce-144 -145	18.903	2.090	2445.0	5.632
	19.726	1.170	2569.0	4.704
Nd-144 -145	19.167	1.940	2479.0	5.482
	20.018	1.180	2607.0	4.714
Nd-145 -146	16.828	1.180	2192.0	4.714
	17.640	2.100	2313.0	5.627
Pm-147 -148	18.462	0.920	2438.0	4.440
	19.294	0.0	2565.0	3.514
Sm-147 -148	18.179	1.220	2400.0	4.740
	19.009	2.140	2527.0	5.654
Sm-149 -150	19.848	1.220	2656.0	4.727
	20.655	2.210	2783.0	5.710
Sm-151 -152	21.263	1.220	2884.0	4.713
	21.320	2.320	2911.0	5.807
Eu-153 -154	25.177	1.100	3460.0	4.580
	24.819	0.0	3433.0	3.474
Eu-155 -156	24.256	0.920	3377.0	4.388
	23.768	0.0	3330.0	3.462

## 5. Results and Remarks

The evaluated cross sections are tabulated in Appendix 2 and are displayed in graphical form in Appendix 3. The evaluated capture cross sections of Benzi et al.<sup>2,3,4)</sup> and Cook<sup>5)</sup> are also plotted in the same graphs for the sake of comparison. The numerical data are stored on magnetic tape in ENDF/B formats, and the details of its content are described in Appendix 1.

The errors in the present evaluation of total, elastic and inelastic scattering cross sections are considered less than 30 % except in the region of low energy resonances. There are some discrepancies between the experimental and calculated total cross sections in a few hundred keV region for mass numbers near 90 and 140, where fission yield is large. But, since the discrepancy is about 30 % at most, the present results are probably satisfactory for reactor calculation.

The values of the excitation cross sections for individual nuclear levels are most unreliable. However, for reactor application, the inelastic total cross section is usually more important than the precise feature of the partial excitation cross section. The inelastic total cross section is calculated with fair accuracy provided that the first few nuclear levels are known.

The angular distributions of elastic scattering were also predicted well by the present optical model as illustrated in Section 3. Therefore, the accuracy of the transport cross section is also considered as satisfactory.

As for the capture cross sections the accuracy of the present results is more difficult to assess. Intercomparison of evaluated data shows that, for nuclides for which even a single measurement exists, there is no large disagreement among the evaluated data in the energy range from a few keV to a few hundred keV. This is not the case for the resonance energy region and the high energy region where the competition with inelastic scattering comes in. In these energy regions, the disagreement is large.

For nuclides whose experimental data do not exist, the disagreement among the evaluated capture cross sections is often very large. Typical examples of these nuclides are  $^{90}\text{Sr}$ ,  $^{93}\text{Zr}$ ,  $^{101}\text{Ru}$ ,  $^{106}\text{Ru}$ ,  $^{105}\text{Pd}$ ,  $^{107}\text{Pd}$ ,  $^{129}\text{I}$ ,  $^{135}\text{Cs}$ , and  $^{144}\text{Ce}$ . In extreme case the disagreement amounts to a factor of 2 to 5 in the energy range from a few keV to 1 MeV, although the present results are generally in closer agreement with the data of Benzi et al. than those of Cook.

Main efforts of future evaluation work will be directed to reduce the uncertainty in the evaluated capture cross sections. There are also several

points which need improvement in the present method of calculation. A provisional scope of future work will be as follows.

(1) Resonance Energy Region:

In the present evaluation, the statistical calculation was simply extrapolated down to 100 eV according to the requirement from reactor physicists. This may be a reasonable method to calculate the cross sections for lumped fission product regarded as a statistical assembly. But, the cross sections of individual nuclides are naturally in significant error. In the next step of evaluation, the experimental data, including the data for resonance integrals, will be studied more extensively in this energy range to minimize the uncertainty in the evaluated cross sections.

(2) Intermediate Energy Range:

In the present calculation, the statistical fluctuation of neutron width was ignored. Also, the variations of neutron strength functions versus mass number were taken into account only in the sense of optical model calculation. These simplifications may have caused some errors in the results.

As for the values of parameters used in calculation, a re-investigation of the systematic trends in these parameters is planned, specifically in the values of average level spacing  $\bar{D}$  of low energy resonances.

(3) High Energy Region:

The capture cross section above a few hundred keV to a few MeV is influenced considerably by the competition with inelastic scattering. The nuclear level schemes of fission product nuclei are not yet established well. The present evaluation of level schemes is only a tentative one, and needs a continuous effort of improvement.

In the present calculation, the direct capture process was not taken into account. Also, as for the energy variation of  $\bar{T}_\gamma$ , the mechanism of photon emission from collectively excited states was not taken into account. Although these effects are not of prime importance in reactor application, they are to be incorporated in the evaluation in next step.

For the future evaluation work, further measurements of cross sections and relevant parameters are very essential and are strongly requested. In particular, the measurements of neutron capture cross section in the energy range from one keV to a few tens of keV are of the greatest importance. Measurements and evaluation of level schemes are also lacking, and the

investigation of these will bring out fruitful results for the future evaluation of the cross sections of fission product nuclides.

## Appendix I. Data Storage and Informations to Users

As mentioned in Sec. 2, we used two computer codes, ELIESE-3<sup>16)</sup> and RACY,<sup>17)</sup> for calculation of cross sections. Total cross section, elastic scattering cross section, inelastic scattering cross section and other quantities obtained by using ELIESE-3 were accumulated on a magnetic tape. After that, content of the magnetic tape were transferred on another magnetic tape with a format similar to the ENDF/B format, by using a program MAKEB.<sup>119)</sup> On the other hand, capture cross section obtained with RACY was prepared on cards and transferred on a magnetic tape with ENDF/B format. The results in these two tapes are combined using a program CRECTJ<sup>120)</sup> which treats the data with the ENDF/B format. Using this program, modification described in Eqs. (2.25) and (2.26) was carried out and final data were stored on the magnetic tape. In this Appendix, contents of the magnetic tape (final tape) obtained here are described in detail for the convenience of using our evaluated data.

At the following energy points (in MeV), cross sections are calculated.

0.0001,	0.0003,	0.001,	0.003,	0.01,	0.02,	0.05,
0.1,	0.2,	0.3,	0.4,	0.5,	0.6,	0.7,
0.8,	0.9,	1.0,	1.25,	1.50,	1.75,	2.0,
2.5,	3.0,	4.0,	6.0,	8.0,	10.0,	11.0,
12.0,	15.0.					

In addition to these points, some energy points are set in the final tape corresponding to the threshold for excitation of the discrete levels. Values of the cross sections at the threshold energy points were obtained by interpolation. Adopted interpolation scheme is linear-linear interpolation (scheme 2) defined in the ENDF/B format, except for the neutron capture cross section. For the neutron capture cross section, interpolation scheme 5 (log-log) is adopted. Quantities stored in the final tape are described below with file number (MF) and section number (MT).

1. Total cross section :  $\sigma_{tot}$  (MF = 3, MT = 1)

Values of the total cross section stored in the final tape are those obtained by using ELIESE-3 and interpolated values at the threshold energies.

2. Elastic scattering cross section:  $\sigma_{el}$  (MF = 3, MT = 2)

The elastic scattering cross section is composed of the shape elastic scattering cross section  $\sigma_{el,s}$  and the compound elastic scattering cross section  $\sigma_{el,c}$ . Though those original values were calculated by ELIESE-3, modification should be applied for the compound elastic scattering cross section as mentioned in Section 2,

$$\sigma_{el,c} = \sigma_{el,c}^o \times \left( \frac{\sigma_c - \sigma_{n,r}}{\sigma_c} \right) \quad (A.1)$$

where  $\sigma_{el,c}^o$  is original value of the compound elastic scattering cross section,  $\sigma_c$  the cross section for compound nucleus formation, and  $\sigma_{n,r}$  the radiative capture cross section. Values of the elastic scattering cross section stored in the final tape were obtained using the following relation,

$$\sigma_{el} = \sigma_{tot} - (\sigma_{in} + \sigma_{n,r})$$

where  $\sigma_{in}$  is the inelastic scattering cross section modified from original value  $\sigma_{in}^o$ ,

$$\sigma_{in} = \sigma_{in}^o \times \frac{\sigma_c - \sigma_{n,r}}{\sigma_c} \quad (A.2)$$

### 3. Inelastic scattering cross section : $\sigma_{in}$ (MF = 3, MT = 4)

As described in Section 2, the inelastic scattering cross section is a sum ( $\sigma_{in}^{(D)}$ ) of the cross sections for excitation of discrete levels, when the incident neutron energy  $E_n$  is lower than an energy  $E_x$  above which levels of residual nucleus are assumed to be overlapping. In the energy region above  $E_x$ , the inelastic scattering cross section is composed of  $\sigma_{in}^{(D)}$  and cross section ( $\sigma_{in}^{(0)}$ ) for excitation of the overlapping levels. As the incident energy  $E_n$  increases further, the compound elastic scattering cross section  $\sigma_{el,c}$  decreases and is negligibly small in the energy region above an energy  $E_o$ . In the calculation with ELIESE-3, the cross section  $\sigma_{in}$  was assumed to be  $\sigma_c$  in this energy region. Further, it was assumed that the cross section  $\sigma_{in}^{(D)}$  was also negligibly small. Thus, in the energy region above  $E_o$ , the inelastic scattering cross section  $\sigma_{in}$  was set equal to  $\sigma_c - \sigma_{n,r}$  finally, which is equal to  $\sigma_{in}^{(0)}$ . Therefore, the following expressions may be given for the inelastic scattering cross section stored in the final tape,

$$\sigma_{in} = \begin{cases} \sigma_{in}^{(D)} & \text{for } E_n \leq E_x, \\ \sigma_{in}^{(D)} + \sigma_{in}^{(0)} & \text{for } E_x < E_n \leq E_o, \\ \sigma_c - \sigma_{n,r} (= \sigma_{in}^{(0)}) & \text{for } E_o < E_n. \end{cases} \quad (A.3)$$

Original values of the cross section  $\sigma_{in}^{(D)}$  and  $\sigma_{in}^{(0)}$  were obtained using ELIESE-3 and were modified as already mentioned in Section 2.

$$\sigma_{in}^{(D)} = \frac{\sigma_c - \sigma_{n,r}}{\sigma_c} \times \sigma_{in}^o \quad (A.3)$$

$$\sigma_{in}^{(0)} = \frac{\sigma_c - \sigma_{in}, r}{\sigma_c} \times \sigma_{in}^o (0)$$

where  $\sigma_{in}^o (0)$  and  $\sigma_{in}^o (0)$  are original values. The value of  $E_x$  is dependent on the knowledge for the level scheme of each nucleus, and is defined as slightly larger energy than the highest energy of the discrete levels adopted here for the nucleus. On the other hand, the energy  $E_o$  is given 6 or 8 MeV in this work.

4. Cross section for inelastic excitation:  $\sigma_{exc}^N$  ( $MF = 3$ ,  $MT = 51 - 90$  for discrete levels,  $MT = 91$  for overlapping levels)

The cross section for excitation of  $N$ -th discrete level is assigned  $MT = 50 + N$  and the cross section for overlapping levels  $MT = 91$ , the latter being stored on the final tape assuming it as the cross section for a discrete level. This means that the cross section  $\sigma_{exc}^{MF=91}$  is  $\sigma_{in}^{(0)}$ . As described above,  $\sigma_{in}$  was set equal to  $\sigma_{in}^{(0)}$  in the energy region above  $E_o$ , and  $\sigma_{in}^{(0)}$  was neglected. In fact, value of the cross section  $\sigma_{in}^{(0)}$  is very small as compared with the cross section  $\sigma_{in}^{(0)}$  at  $E_n = E_o$ , though some cross sections  $\sigma_{exc}^N$  for higher excited levels do not decrease sufficiently at  $E_n = E_o$ .

5. Neutron capture cross section :  $\sigma_{n,r}$  ( $MF = 3$ ,  $MT = 102$ )

Values of capture cross section stored in the final tape are those based on the calculation by RACY code. Interpolation scheme selected is 5 (log-log interpolation).

6. Average cosine of the scattering angle :  $\mu_L$  ( $MF = 3$ ,  $MT = 251$ )

The average cosine  $\mu_L$  of the scattering angle for elastic scattering cross section in laboratory system is calculated by the following expression,

$$\mu_L = B_1^L / 3B_0^L , \quad (A.4)$$

where  $B_0^L$  and  $B_1^L$  are 1-st and 2-nd order coefficients for Legendre expansion of the differential elastic scattering cross section in laboratory system and these are obtained by using ELIESE-3.

7. Coefficients for Legendre expansion of differential elastic scattering cross section :  $f_i$  ( $MF=4$ ,  $MT=2$ )

Scattering probability  $P(\mu_c, E_n)$  for the differential elastic scattering cross section is defined in ENDF/B as follows,

$$\begin{aligned} P(\mu_c, E_n) &= \frac{2\pi}{\sigma_{el}(E_n)} \frac{d\sigma_{el}(E_n, \Omega_c)}{d\Omega_c} \\ &= \sum_{i=0}^{\infty} \frac{2\ell+1}{2} f_i(E_n) P_i(\mu_c) \end{aligned} \quad (A.5)$$

where  $\mu_C$  is the cosine of scattering angle in the center of mass system,  $E_n$  the incident neutron energy,  $\sigma_{el}(E_n)$  the elastic scattering cross section and  $f_l$  the  $l$ -th coefficient for Legendre expansion of the differential elastic scattering cross section in the center of mass system.

In ELIESE -3, on the other hand, Legendre expansion is expressed as,

$$\frac{d\sigma_{el}(E_n, \Omega_C)}{d\Omega_C} = \sum_{l=0}^{\infty} B_l^0(E_n) P_l(\mu_C), \quad (A.6)$$

and

$$\frac{d\sigma_{el}(E_n, \Omega_L)}{d\Omega_L} = \sum_{l=0}^{\infty} B_l^L(E_n) P_l(\mu_L). \quad (A.7)$$

Therefore, the coefficient  $f_l(E_n)$  is written as,

$$f_l(E_n) = \frac{1}{2\ell+1} \frac{B_l^0(E_n)}{B_l^L(E_n)} \quad (A.8)$$

Transformation matrix  $T_{ll'}$  for Legendre expansion coefficients from center of mass system to laboratory system is expressed as,

$$T_{ll'} = \frac{2\ell+1}{2} \int_{-1}^1 d\mu_C P_{l'}(\mu_L) P_l(\mu_C) \quad (A.9)$$

with the relation between  $\mu_C$  and  $\mu_L$ .

In this work, the transformation matrix  $T_{ll'}$  was obtained by using a program MAKEB<sup>119)</sup>, and was stored in the final tape as well as the coefficient  $f_l(E_n)$ .

Data for nuclides shown in Table A-1 are stored in the file with the ENDF/B format. In Table A-2, reaction types are shown together with MF and MT number, a section for general description (MF=1 and MT=451) and a section for resonance parameters (MF=2 and MT=151) are prepared also, but the section for resonance parameter contains scattering length and spin of the nucleus, only.

The data in the final tape were checked with codes CHECKER<sup>121)</sup>, SUMUP<sup>122)</sup>, and SPLINT<sup>123)</sup> in order to check the data format and to confirm the consistency among the data. Graphical plots of the data will be shown with the code SPLINT in APPENDIX 3 and the numerical values of the data will be presented in APPENDIX 2.

Table A-1 Nucleus in the final tape

No.,	MAT No	Nucleus	No	MAT No	nucleus
1	3890	$^{90}\text{Sr}$	15	5431	$^{131}\text{Xe}$
2	4093	$^{93}\text{Zr}$	16	5533	$^{133}\text{Cs}$
3	4295	$^{95}\text{Mo}$	17	5535	$^{135}\text{Cs}$
4	4297	$^{97}\text{Mo}$	18	5537	$^{137}\text{Cs}$
5	4399	$^{99}\text{Tc}$	19	5844	$^{144}\text{Ce}$
6	4401	$^{101}\text{Ru}$	20	6043	$^{143}\text{Nd}$
7	4402	$^{102}\text{Ru}$	21	6044	$^{144}\text{Nd}$
8	4404	$^{104}\text{Ru}$	22	6045	$^{145}\text{Nd}$
9	4406	$^{106}\text{Ru}$	23	6147	$^{147}\text{Pm}$
10	4503	$^{103}\text{Rh}$	24	6247	$^{147}\text{Sm}$
11	4605	$^{105}\text{Pd}$	25	6249	$^{149}\text{Sm}$
12	4607	$^{107}\text{Pd}$	26	6251	$^{151}\text{Sm}$
13	4709	$^{109}\text{Ag}$	27	6353	$^{153}\text{Eu}$
14	5329	$^{129}\text{I}$	28	6355	$^{155}\text{Eu}$

Table A-2 Reactions in the final tape

The final tape contains MF = 1, MT = 451 (general discription) and MF = 2, MT = 151 9 resonance parameters). But MF = 2, MT = 151 contains only scattering length and spin of the nucleus.

reaction	MF	MT
total cross section	3	1
elastic scattering cross section	3	2
inelastic scattering cross section	3	4
1st level excitation cross section	3	51
2nd level excitation cross section	3	52
.....	.	.
.....	.	.
continuum level excitation cross section	3	91
capture cross section	3	102
	3	251
differential elastic scattering cross section	4	2

## Appendix 2. Tables of Cross Sections

TABLE A2 - 1

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PARAMETERS	CROSS SECTION(BARN) AND MU-BAR					
	ENERGY(EV)	TOTAL	ELASTIC	INELASTIC	CAPTURE	MU-BAR
NEUTRON SEPARATION ENERGY 5.801E 00(MEV)						
LEVEL PARAMEETER(XI=ZERO) 1.863E 04	100.0000+0	24.9800+0	24.1560+0		784.0000-3	7.4742-3
LEVEL SPACING ..... 1.200E 04 (MEV)	300.0000+0	17.0087+0	16.6297+0		374.0000-3	7.4639-3
LEVEL DENSITY PARAMETER 1.055E 01(1/MEV) TAG.	1.0000+3	12.1911+0	11.9591+0		232.0000-3	7.4639-3
PAIRING ENERGY 1.960E 00(MEV) TAG.	3.0000+3	8.8562+0	9.7362+0		120.0000-3	7.5749-3
PAIRING ENERGY 1.240E 00(MEV) COM.	10.0000+3	8.6560+0	8.6137+0		42.4000-3	8.7630-3
NORMALIZATION FACTOR 8.529E 02(1/MEV) TAG.	20.0000+3	8.4108+0	8.3881+0		22.7000-3	11.7469-3
TANGENCY POINT ..... 6.127E 00(MEV) TAG.	50.0000+3	8.4516+0	8.4393+0		12.3000-3	25.5592-3
5.388E 00(MEV) COM.	100.0000+3	8.6347+0	8.6236+0		11.1000-3	56.0329-3
200.0000+3	8.6747+0	8.6631+0			11.6000-3	122.0430-3
300.0000+3	8.6421+0	8.6302+0			11.9000-3	180.7610-3
ADOPTED LEVELS (MEV)						
1. GROUND 0+	400.0000+3	8.0938+0	8.0822+0		11.6000-3	228.3290-3
2. 0.8315 2+	500.0000+3	7.7090+0	7.6978+0		11.2000-3	265.3770-3
3. 1.6555 0+	600.0000+3	7.3260+0	7.3148+0		11.2000-3	293.4850-3
4. 1.8921 2+	700.0000+3	6.9618+0	6.9506+0		11.2000-3	314.2390-3
5. 2.2068 4+	800.0000+3	6.6240+0	6.6125+0		11.5000-3	328.9480-3
840.8190+3	6.4979+0	6.4894+0	0.0 +0		8.5361-3	343.0036-3
900.0000+3	6.3151+0	5.8740+0	435.4260-3		5.6800-3	363.3820-3
1.0000+6	6.0348+0	5.1556+0	875.1590-3		4.0700-3	401.8140-3
1.2500+6	5.4488+0	4.1803+0	1.2649+0		3.5300-3	447.8470-3
1.5000+6	4.9981+0	3.6268+0	1.3674+0		3.8600-3	457.6630-3
1.6741+6	4.7565+0	3.3345+0	1.4177+0		4.2852-3	457.2919-3
1.7500+6	4.6510+0	3.2070+0	1.4396+0		4.4700-3	457.1300-3
1.9133+6	4.4763+0	2.9603+0	1.5110+0		4.7723-3	459.5731-3
2.0000+6	4.3832+0	2.8295+0	1.5468+0		4.9300-3	460.1700-3
2.2315+6	4.2154+0	2.5968+0	1.6148+0		3.8251-3	464.3254-3
2.5000+6	4.0208+0	2.3266+0	1.6913+0		2.9600-3	468.3320-3
2.5280+6	4.0094+0	2.3124+0	1.6941+0		2.8369-3	469.2382-3
3.0000+6	3.8173+0	2.0737+0	1.7420+0		1.6400-3	464.5020-3
4.0000+6	3.7078+0	2.0116+0	1.6954+0	846.0000-6	535.1130-3	
6.0000+6	4.0878+0	2.3664+0	1.7211+0		320.0000-6	669.6400-3
8.0000+6	4.3842+0	2.6232+0	1.7609+0	130.0000-6	788.8700-3	
10.0000+6	4.3510+0	2.6806+0	1.6703+0	60.0000-6	838.9180-3	
12.0000+6	4.2703+0	2.6265+0	1.6438+0	40.0000-6	852.0210-3	
12.0000+6	4.1779+0	2.5358+0	1.6396+0	30.0000-6	859.9140-3	
15.0000+6	3.9174+0	2.2012+0	1.7162+0	10.0000-6	864.4180-3	

## CROSS SECTION FOR EXCITATION OF LEVELS

ENERGY(EV)	1-ST	2-ND	3-TH	4-TH
840.8190+3	0.0 +0			
900.0000+3	435.4260-3			
1.0000+6	875.1590-3			
1.2500+6	1.2649+0			
1.5000+6	1.3674+0			
1.6741+6	1.3777+0	0.0 +0		
1.7500+6	1.3622+0	57.3580-3		
1.9133+6	1.2917+0	135.4881-3	0.0 +0	
2.0000+6	1.2284+0	176.9620-3	143.4640-3	
2.2315+6	1.0539+0	176.7351-3	303.7406-3	0.0 +0
2.5000+6	851.4680-3	176.4720-3	485.5890-3	173.4520-3
2.5280+6	839.6445-3	174.4711-3	486.6175-3	177.0399-3
3.0000+6	629.7780-3	140.7670-3	436.5650-3	237.4760-3
4.0000+6	470.4870-3	112.7700-3	375.4160-3	258.3040-3
6.0000+6	299.6170-3	76.9305-3	289.1630-3	272.8160-3
8.0000+6				
10.0000+6				
11.0000+6				
12.0000+6				
15.0000+6				

TABLE A2 - 2  
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PARAMETERS		CROSS SECTION(BARN) AND MU-BAR							
		ENERGY(EV)	TOTAL	ELASTIC	INELASTIC	CAPTURE	MU-BAR		
NEUTRON SEPARATION ENERGY	8.228E 00(MEV)								
LEVEL PARAMETER(XI=ZERO)	1.010E 03	100.0000*0	22.548*0	13.0789*0		9.4700*0	7.2406*3		
LEVEL SPACING .....	3.000E 02(MEV)	300.0000*0	15.5891*0	11.3091*0		4.2800*0	7.2542*3		
LEVEL DENSITY PARAMETER ..	1.13E 01(1/MEV)	1.0000*3	11.3939*0	9.5339*0		1.8800*0	7.3399*3		
PAIRING ENERGY .....	1.215E 01(1/MEV)	1.215E 01(1/MEV)	1.0000*3	9.4114*0	8.4014*0	1.0100*0	7.7508*3		
PAIRING ENERGY .....	2.00E 00(MEV)	2.00E 00(MEV)	10.0000*3	8.4933*0	7.9803*0	513.0000*3	10.1213*3		
NORMALIZATION FACTOR .....	9.306E 02(1/MEV)	20.0000*3	8.3969*0	8.0969*0		306.0000*3	14.8673*3		
TANGENCY POINT .....	5.313E 00(MEV)	50.0000*3	8.6374*0	8.4964*0		141.0000*3	33.7326*3		
COM. ....	6.416E 00(MEV)	100.0000*3	8.9548*0	8.8732*0		81.6000*3	71.0486*3		
COM. ....		200.0000*3	9.0594*0	9.0033*0		56.1000*3	144.9750*3		
ADOPTED LEVELS (MEV)		269.8960*3	8.8909*0	8.8398*0	0.0 +0	51.0661*3	190.4046*3		
1.	GROUND	5/2+	300.0000*3	8.8182*0	8.6195*0	149.3760*3	49.4000*3		
2.		3/2+	400.0000*3	8.4512*0	7.8450*0	558.5970*3	47.6000*3		
3.		1/2+	500.0000*3	8.0567*0	7.2829*0	719.8390*3	47.9000*3		
4.		5/2+	600.0000*3	7.6561*0	6.8431*0	764.2100*3	48.8000*3		
5.		3/2+	700.0000*3	7.2829*0	6.4699*0	763.2700*3	49.7000*3		
6.	1+652	7/2+	800.0000*3	6.1397*0	746.6820*3	50.7000*3	392.0820*3		
7.	1+910	1/2+	900.0000*3	6.6200*0	5.8412*0	726.9600*3	51.9000*3		
8.	1+993	5/2+	957.2710*3	6.4544*0	5.6808*0	720.9610*3	52.6573*3		
9.	2.181	1/2+	1.0000*6	6.3308*0	5.5611*0	716.4920*3	53.2000*3		
10.	2+453	1/2+	1.2500*6	5.7177*0	4.9330*0	727.1360*3	57.6000*3		
11.	2+468	3/2+	1.4405*6	5.3499*0	4.5122*0	776.4020*3	61.3002*3		
12.	2+605	1/2+	1.4667*6	5.2991*0	4.4541*0	783.1790*3	61.7887*3		
13.	2.773	3/2+	1.5000*6	5.2349*0	4.3807*0	791.7490*3	62.4000*3		
		1.6699*6	4.9763*0	3.9390*0	974.9380*3	62.4000*3			
		1.7500*6	4.8544*0	3.7308*0	1.0612*0	62.4000*3	431.1200*3		
		1.9307*6	4.6377*0	3.5991*0	1.1750*0	62.6207*3	434.9310*3		
		2.0000*6	4.5546*0	3.2720*0	1.2199*0	62.7000*3	435.3920*3		
		2.0146*6	4.5242*0	3.2557*0	1.2236*0	62.8753*3	436.2855*3		
		2.2046*6	4.3821*0	3.0466*0	1.2724*0	65.0861*3	434.9013*3		
		2.4796*6	4.1505*0	2.7397*0	1.3427*0	68.0858*3	432.8986*3		
		2.4948*6	4.1377*0	2.7229*0	1.3466*0	68.2452*3	432.7881*3		
		2.5000*6	4.1333*0	2.7171*0	1.3479*0	68.3000*3	432.7500*3		
		2.6337*6	4.0656*0	2.6211*0	1.3928*0	51.7035*3	438.3164*3		
		2.8031*6	3.9794*0	2.4617*0	1.4507*0	36.9833*3	445.4109*3		
		2.8304*6	3.9655*0	2.4703*0	1.4601*0	35.1114*3	446.5509*3		
		3.0000*6	3.8794*0	2.3350*0	1.5187*0	25.7000*3	453.6370*3		
		4.0000*6	3.7134*0	2.0920*0	1.6179*0	3.4800*3	510.4980*3		
		6.0000*6	4.0777*0	2.3790*0	1.6678*0	910.0000*6	648.2520*3		
		8.0000*6	4.3748*0	2.6094*0	1.7651*0	320.0000*6	786.2910*3		
		10.0000*6	4.3763*0	2.6980*0	1.6782*0	140.0000*6	837.9100*3		
		11.0000*6	4.3227*0	2.6591*0	1.6635*0	100.0000*6	851.7300*3		
		12.0000*6	4.2583*0	2.5552*0	1.6729*0	70.0000*6	860.4150*3		
		15.0000*6	4.0384*0	2.2781*0	1.7602*0	30.0000*6	867.6800*3		
CROSS SECTION FOR EXCITATION OF LEVELS									
ENERGY(EV)	1-ST	2-ND	3-TH	4-TH	5-TH	6-TH	7-TH	8-TH	9-TH
269.8960*3	0.0 +0								
300.0000*3	149.3760*3								
400.0000*3	558.5970*3								
500.0000*3	719.8390*3								
600.0000*3	764.2100*3								
700.0000*3	763.2700*3								
800.0000*3	746.6820*3								
900.0000*3	726.9600*3								
957.2710*3	711.4779*3	0.0 +0							
1.0000*6	699.9270*3	16.5653*3							
1.2500*6	625.5540*3	101.5820*3							
1.4405*6	588.0715*3	117.8590*3	0.0 +0						
1.4667*6	582.8986*3	120.0743*3	32.9918*3	0.0 +0					
1.5000*6	576.3540*3	122.9120*3	74.7463*3	17.7362*3					
1.6699*6	485.6160*3	112.0371*3	211.0450*3	93.9411*3	0.0 +0				
1.7500*6	442.8530*3	106.9120*3	275.2800*3	129.8550*3	106.3070*3				
1.9307*6	388.8712*3	102.0846*3	284.3659*3	145.5270*3	248.8770*3	0.0 +0			
2.0000*6	368.1770*3	100.2340*3	287.8490*3	151.5350*3	303.5320*3	8.5622*3			
2.0146*6	365.9500*3	99.8731*3	287.1105*3	151.2275*3	304.6499*3	9.4860*3	0.0 +0		
2.2046*6	337.0035*3	95.1620*3	277.5117*3	147.2308*3	319.1804*3	21.4946*3	60.6825*3	0.0 +0	
2.4796*6	295.1215*3	88.3945*3	243.6235*3	141.4461*3	340.2041*3	38.8695*3	148.4262*3	23.2526*3	0.0 +0
2.4948*6	292.8407*3	88.0200*3	262.8572*3	141.1290*3	341.3641*3	39.8281*3	153.3269*3	24.5355*3	957.2939*6
2.5000*6	292.0340*3	87.8909*3	262.5930*3	141.0190*3	341.7640*3	40.1586*3	154.9970*3	24.9778*3	1.2873*3
2.6332*6	272.0511*3	85.9634*3	233.7093*3	136.6649*3	320.9340*3	39.6019*3	155.5153*3	26.4398*3	7.1291*3
2.8031*6	246.6308*3	78.9576*3	242.3873*3	131.1246*3	317.1309*3	38.8923*3	156.1760*3	28.3031*3	14.5745*3
2.8304*6	242.5544*3	78.1532*3	240.5679*3	130.2337*3	314.9128*3	38.7782*3	156.2821*3	28.6026*3	15.7709*3
3.0000*6	217.1440*3	73.1534*3	229.2500*3	124.6960*3	301.1260*3	38.0695*3	156.9420*3	30.4637*3	23.2075*3
4.0000*6	128.2270*3	52.0761*3	176.1230*3	101.4130*3	240.1190*3	37.8778*3	142.2210*3	32.9322*3	27.9783*3
6.0000*6	76.2464*3	33.7643*3	117.7820*3	69.8893*3	175.0900*3	30.9491*3	111.8420*3	30.0412*3	29.0297*3
8.0000*6									
10.0000*6									
11.0000*6									
12.0000*6									
15.0000*6									

TABLE A2 - 3  
NUCLEUS ... 42-MO- 95

PARAMETERS		CROSS SECTION(BARN) AND MU-BAR							
		ENERGY(EV)	TOTAL	ELASTIC	INELASTIC	CAPTURE	MU-BAR		
NEUTRON SEPARATION ENERGY	9.156E 00(MEV)								
LEVEL PARAMETER(XI)=ZERO)	7.346E 02	ABOVE 0.2MEV	100.0000+0	21.3256+0	10.0256+0	11.3000+0	7.0930+3		
	1.019E 03	BELLOW 0.2MEV	300.0000+0	14.8555+0	9.2855+0	5.5700+0	7.1234+3		
LEVEL SPACING .....	1.000E 02(MEV)	ABOVE 0.2MEV	1.0000+3	10.9764+0	8.3864+0	2.5900+0	7.2482+3		
	1.387E 02	BELLOW 0.2MEV	3.0000+3	9.1776+0	7.7176+0	1.4600+0	7.9706+3		
LEVEL DENSITY PARAMETER ..	1.137E 01(1/MEV)	AG.	10.0000+3	8.4332+0	7.5962+0	817.0000-3	11.3760+3		
	1.215E 01(1/MEV)	CDM							
PAIRING ENERGY .....	1.28D0 00(MEV)	TAG	20.0000+3	8.4011+0	7.8811+0	520.0000-3	17.5796+3		
	2.40D0 00(MEV)	CDM	50.0000+3	8.7511+0	8.4991+0	252.0000-3	40.2900+3		
NORMALIZATION FACTOR .....	9.697E 02(1/MEV)	TAG	100.0000+3	9.1327+0	8.9627+0	170.0000-3	82.2585+3		
TANGENCY POINT .....	5.359E 00(MEV)	TAG	200.0000+3	9.2534+0	9.1334+0	120.0000-3	160.7560+3		
	6.463E 00(MEV)	COM	206.1050+3	9.2380+0	9.1198+0	0.0 +0	118.1484+3		
ADOPTED LEVELS (MEV)									
1,	GROUND	5/2+							
2,	0.20394	3/2+							
3,	0.76593	7/2+							
4,	0.7862	1/2+							
5,	0.82065	3/2+							
6,	0.84978	9/2+							
7,	1.0391	1/2+							
8,	1.059	5/2+							
9,	1.0741	7/2+							
10,	1.2225	5/2+							
11,	1.310	1/2+							
12,	1.376	3/2+							
13,	1.433	5/2+							
1,	773.9610+3		7.1727+0	6.2702+0	8.3190+0	97.3000+3	237.7200+3		
2,	800.0000+3		8.6251+0	7.7491+0	7.8432+0	91.7000+3	297.8140+3		
3,	800.0000+3		8.2210+0	7.2897+0	8.3883+0	92.4000+3	340.8020+3		
4,	800.0000+3		6.1612+0	6.1612+0	6.6550+0	94.1352+3	410.9332+3		
5,	800.0000+3		6.1703+0	6.1703+0	8.4297+0	93.9000+3	411.9960+3		
6,	800.0000+3		6.0020+0	6.0020+0	9.2211+0	89.7817+3	421.4861+3		
7,	829.3630+3		7.0139+0	6.4953+0	8.0046+0	98.6000+3	392.5420+3		
8,	829.3630+3		6.7495+0	6.5537+0	8.0046+0	98.6000+3	444.3160+3		
9,	829.3630+3		6.7495+0	6.5537+0	8.0046+0	81.1000+3	444.3160+3		
10,	957.8630+3		6.2111+0	5.3162+0	1.2340+0	70.8921+3	460.2521+3		
11,	1.0000+6		6.4065+0	5.1114+0	1.3225+0	64.6000+3	471.8570+3		
12,	1.0501+6		6.3738+0	4.9311+0	1.3638+0	58.8739+3	481.2784+3		
13,	1.0702+6		6.3237+0	4.8585+0	1.4085+0	56.7524+3	485.0579+3		
	1.0855+6		6.2858+0	4.8033+0	1.4272+0	55.2870+3	487.9259+3		
1,	1.2355+6		5.9125+0	4.2572+0	1.6120+0	43.2483+3	516.1131+3		
2,	1.2500+6		5.8764+0	4.2041+0	1.6300+0	42.3000+3	526.8420+3		
3,	1.3239+6		5.7297+0	4.0364+0	1.6539+0	42.0973+3	523.1790+3		
4,	1.3006+6		5.5973+0	3.8164+0	1.6755+0	40.0957+3	527.0930+3		
5,	1.4482+6		5.4829+0	3.7494+0	1.6942+0	39.2870+3	530.4730+3		
6,	1.5000+6		5.3801+0	3.6306+0	1.7109+0	38.6000+3	533.5120+3		
7,	1.5563+6		5.2908+0	3.5356+0	1.7228+0	34.4820+3	534.0827+3		
8,	1.7500+6		4.9193+0	3.1962+0	1.7537+0	24.0000+3	536.2950+3		
9,	2.0000+6		4.6670+0	2.8856+0	1.7869+0	16.6000+3	531.2950+3		
10,	2.5000+6		4.2093+0	2.4472+0	1.7809+0	11.4000+3	515.5900+3		
11,	3.0000+6		3.9222+0	2.1581+0	1.7551+0	9.0700+3	509.6180+3		
12,	4.0000+6		3.7164+0	1.9671+0	1.7155+0	5.7800+3	532.3010+3		
13,	6.0000+6		4.0467+0	2.3080+0	1.7569+0	2.3300+3	655.6680+3		
	8.0000+6		4.3656+0	2.5972+0	1.7675+0	870.0000-6	784.1240+3		
10,	10.0000+6		4.3950+0	2.7071+0	1.6676+0	370.0000-6	836.8050+3		
11,	11.0000+6		4.3613+0	2.6793+0	1.6817+0	260.0000-6	851.2080+3		
12,	12.0000+6		4.3164+0	2.6161+0	1.7001+0	190.0000-6	860.5320+3		
13,	13.0000+6		4.1147+0	2.3293+0	1.7853+0	80.0000-6	869.7630+3		
CROSS SECTION FOR EXCITATION OF LEVELS									
ENERGY(EV)	1-ST	2-ND	3-TH	4-TH	5-TH	6-TH	7-TH	8-TH	9-TH
206.1050+3	0.0 +0								
300.0000+3	546.6960+3								
400.0000+3	784.3200+3								
500.0000+3	838.8830+3								
600.0000+3	829.5230+3								
700.0000+3	800.4600+3								
773.9610+3	766.7930+3	0.0 +0							
794.5470+3	757.4222+3	67.6370+3	0.0 +0						
800.0000+3	754.9400+3	85.8062+3	2.2253+3						
829.3630+3	713.6712+3	169.4549+3	16.1855+3	0.0 +0					
900.0000+3	615.0740+3	370.6840+3	49.7667+3	77.5949+3					
957.8630+3	551.4785+3	437.4785+3	66.1899+3	127.5903+3	0.0 +0				
1.0000+6	505.1670+3	485.9400+3	78.1642+3	163.9980+3	89.2790+3				
1.0501+6	467.3134+3	466.2979+3	78.8319+3	168.9091+3	128.3628+3	0.0 +0			
1.0702+6	452.1288+3	458.4183+3	79.1062+3	170.8793+3	144.0415+3	4.2523+3	0.0 +0		
1.0855+6	440.6660+3	452.4390+3	79.3143+3	172.3743+3	155.9389+3	7.4790+3	13.3260+3	0.0 +0	
1.2355+6	327.3560+3	393.6733+3	81.3599+3	187.0675+3	272.8705+3	39.1922+3	144.2982+3	147.88+3	10.1926+3
1.2500+6	316.3920+3	387.9840+3	81.5579+3	188.4900+3	284.1910+3	42.2625+3	156.9780+3	161.9820+3	136.1270+3
1.3239+6	289.0539+3	363.3610+3	76.8128+3	176.9390+3	287.0640+3	44.4939+3	166.8612+3	179.3500+3	46.5278+3
1.3906+6	264.3826+3	341.0759+3	72.5306+3	166.5149+3	289.6568+3	46.4989+3	175.7804+3	195.0237+3	79.3184+3
1.4482+6	243.0773+3	321.7898+3	68.8327+3	157.5130+3	291.8058+3	48.2343+3	163.4826+3	208.5590+3	107.6353+3
1.5000+6	223.9210+3	304.4940+3	65.5077+3	149.4100+3	293.9090+3	49.7947+3	190.4080+3	220.7290+3	133.0960+3
1.5563+6	213.3306+3	293.3331+3	63.2673+3	143.4076+3	288.7462+3	48.8656+3	185.8869+3	218.2201+3	136.1270+3
1.7500+6	176.9360+3	254.9780+3	55.5681+3	122.7490+3	271.0090+3	45.6725+3	170.3500+3	209.5980+3	186.5430+3
2.0000+6	152.7500+3	229.2700+3	51.2625+3	109.8580+3	251.4440+3	43.3592+3	154.5350+3	195.9860+3	139.9670+3
2.5000+6	132.9630+3	208.3260+3	49.6406+3	102.4070+3	223.0960+3	43.1531+3	141.9350+3	161.6580+3	130.7460+3
3.0000+6	115.6480+3	188.6790+3	47.6593+3	96.5271+3	198.1180+3	42.9064+3	133.6490+3	168.8950+3	124.6100+3
4.0000+6	85.4878+3	150.4480+3	39.6870+3	79.5157+3	162.1890+3	37.9969+3	114.1550+3	143.5400+3	110.5240+3
6.0000+6	56.8686+3	106.1890+3	27.9523+3	55.7674+3	122.4820+3	27.6617+3	82.0880+3	105.1860+3	81.5537+3
8.0000+6									
10.0000+6									
11.0000+6									
12.0000+6									
13.0000+6									

TABLE A2 - 4  
NUCLEUS ... 42-Mo- 97

PARAMETERS		CROSS SECTION(BARN) AND MU-BAR							
		ENERGY(EV)	TOTAL	ELASTIC	INELASTIC	CAPTURE	MU-BAR		
NEUTRON SEPARATION ENERGY ..	8.642E 00(MEV)								
LEVEL PARAMETER(X1=ZERO) ..	8.815E 02	ABOVE 0.1MEV	160.00000+0	20.32197+0	9.02197+0	11.30000+0	6.99427+3		
	1.064E 03	BELOW 0.1MEV	121.01910+0	25.28737+0	9.02030+0	11.22704+0	7.00013+3		
LEVEL SPACING .....	1.200E 02(MEV)	ABOVE 0.1MEV	300.00000+0	14.74330+0	8.56330+0	5.68000+0	7.00953+3		
	1.448E 02	BELOW 0.1MEV	1.00000+3	10.61660+0	7.88660+0	2.73000+0	7.28793+3		
LEVEL DENSITY PARAMETER ..	1.793E 01(1/MEV)	COM.	3.00000+3	9.97060+0	7.39070+0	1.58000+0	8.34813+3		
PAIRING ENERGY .....	1.280E 00(MEV)	TAG.	10.00000+3	8.33764+0	7.53164+0	806.00000+3	13.12263+3		
	2.570E 00(MEV)	COM.	20.00000+3	8.39784+0	7.88984+0	508.00000+3	21.15543+3		
NORMALIZATION FACTOR ..	1.126E 03(1/MEV)	TAG.	50.00000+3	8.38484+0	8.29544+0	243.00000+3	48.37023+3		
TANGENCY POINT .....	5.326E 00(MEV)	TAG.	100.00000+3	9.26240+0	9.12240+0	140.00000+3	95.32203+3		
	6.601E 00(MEV)	COM.	200.00000+3	9.38230+0	9.27430+0	108.00000+3	178.09000+3		
ADOPTED LEVELS (MEV)			300.00000+3	9.12024+0	9.02464+0	95.60000+3	241.24703+3		
			400.00000+3	8.76390+0	8.64964+0	94.30000+3	287.71000+3		
			485.90100+3	8.40130+0	8.30630+0	0.0 +0	94.9971+3		
			500.00000+3	8.34510+0	8.20520+0	44.76203+0	95.10000+3		
			600.00000+3	7.97570+0	7.44657+0	375.61703+0	95.40000+3		
			700.00000+3	7.17200+0	7.05967+0	572.42403+0	87.97663+3		
			7.61400+0	6.91730+0	6.73100+0	318.21093+0	386.38743+3		
			7.82950+0	6.78340+0	6.63400+0	84.50000+3	398.91703+3		
			7.92600+0	6.60180+0	6.208690+0	79.87073+0	412.70733+0		
			728.59807+0	7.45457+0	6.58357+0	832.30403+0	79.53813+3		
			800.00000+3	7.25327+0	5.96607+0	1.2182+0	69.00000+3		
			897.23406+3	6.84840+0	5.44380+0	1.4402+0	64.90643+3		
			900.00000+3	6.74030+0	5.42897+0	1.44657+0	64.80000+3		
			1.00000+6	6.69230+0	5.0760+0	1.5123+0	64.00000+3		
			1.03557+0	6.56467+0	4.9710+0	1.5331+0	60.4470+0		
			1.1167+0	6.38380+0	4.7567+0	1.5738+0	54.3704+3		
			1.2688+0	6.33330+0	4.6926+0	1.5883+0	52.4494+3		
			1.2845+0	6.32070+0	4.5227+0	1.6607+0	44.50000+3		
			1.4095+0	6.26240+0	4.4394+0	1.6699+0	42.5283+0		
			1.4973+0	6.17100+0	4.2183+0	4.2183+0	33.8258+0		
			1.5136+0	6.13440+0	4.1643+0	4.6195+0	33.6368+0		
			1.1240+6	6.13480+0	4.7874+0	1.7724+0	34.7702+3		
			1.1283+6	6.13330+0	4.7870+0	1.7190+0	542.5268+3		
			1.2520+6	6.02070+0	4.5227+0	1.6607+0	532.1910+3		
			1.2900+6	5.96630+0	4.4394+0	1.6699+0	42.5283+0		
			1.2979+6	5.93440+0	4.2183+0	4.2183+0	33.8258+0		
			1.4242+6	5.68060+0	3.9236+0	1.7109+0	35.8845+3		
			1.4523+6	5.6738+0	3.8701+0	1.7190+0	34.7702+3		
			1.5000+6	5.5757+0	3.7620+0	1.7328+0	33.0000+3		
			1.5314+6	5.4766+0	3.7062+0	1.7396+0	30.8547+3		
			1.5611+6	5.4282+0	3.6531+0	1.7460+0	28.9876+3		
			1.7500+6	5.1199+0	3.3127+0	1.7872+0	20.0000+3		
			2.0000+6	4.7874+0	2.9601+0	1.8135+0	13.7000+3		
			2.5000+6	4.2919+0	2.4674+0	1.8154+0	9.0500+3		
			3.0000+6	3.9689+0	2.1639+0	1.7980+0	6.9200+3		
			4.0000+6	3.17240+0	2.1749+0	1.7333+0	70.0000+6		
			15.0000+6	4.1908+0	2.3838+0	1.8070+0	20.0000+6		
							871.9250+3		
CROSS SECTION FOR EXCITATION OF LEVELS									
ENERGY(EV)	1-ST	2-ND	3-TH	4-TH	5-TH	6-TH	7-TH	8-TH	9-TH
485.90100+3	0.0 +0								
500.00000+3	44.7620+3								
600.00000+3	375.6170+3								
665.00000+3	469.6390+3	0.0 +0							
686.66700+3	500.88466+3	92.82999+3	0.0 +0						
700.00000+3	520.15000+3	150.07000+3	5.1168+3						
726.47700+3	498.62893+3	225.06103+3	23.9666+3	0.0 +0					
728.59800+3	496.90404+3	231.0675+3	25.2394+3	5.2454+3	0.0 +0				
800.00000+3	478.8510+3	433.2460+3	67.9860+3	181.8270+3	96.2512+3				
897.23400+3	357.7345+3	309.5878+3	314.6944+3	171.6550+3	0.0 +0				
900.00000+3	355.4270+3	511.7580+3	86.2764+3	318.4740+3	173.8000+3	78.9620+6			
1.00000+6	303.3640+3	532.1610+3	66.3095+3	364.1400+3	107.1270+3	29.2299+3			
1.0353+6	281.6929+3	514.4213+3	84.7990+3	356.9906+3	194.5302+3	32.9926+3	0.0 +0		
1.1040+6	248.9433+3	470.8429+3	61.8566+3	343.0584+3	148.4665+3	60.3445+3	68.3788+3	0.0 +0	
1.1283+6	260.8811+3	467.5887+3	80.8111+3	338.1162+3	187.6747+3	42.9500+3	87.1939+3	10.8404+3	0.0 +0
1.2500+6	220.5900+3	406.3480+3	75.5964+3	313.4350+3	178.7100+3	55.9767+3	201.2130+3	65.0154+3	143.8440+3
1.2820+6	214.3068+3	392.0615+3	74.2433+3	304.0986+3	174.5150+3	55.7269+3	203.2027+3	63.4769+3	151.2561+3
1.2979+6	211.1897+3	384.9741+3	73.5721+3	299.6667+3	172.4338+3	55.6059+3	204.1897+3	71.6902+3	154.9332+3
1.4242+6	166.7600+3	277.3192+3	63.6033+3	226.8125+3	140.9722+3	53.3590+3	208.6050+3	59.6076+3	192.0037+3
1.4523+6	180.8657+3	316.0244+3	67.0419+3	254.4142+3	152.1877+3	54.4292+3	213.7921+3	59.3074+3	164.1969+3
1.5000+6	171.4870+3	294.7000+3	65.0222+3	240.4810+3	145.9260+3	54.0652+3	216.7620+3	59.6817+3	201.7690+3
1.5314+6	168.0326+3	285.7748+3	64.2936+3	234.4851+3	143.3822+3	53.7025+3	212.5733+3	59.7410+3	196.7544+3
1.5611+6	164.7600+3	277.3192+3	63.6033+3	226.8125+3	140.9722+3	53.3590+3	208.6050+3	59.6076+3	192.0037+3
1.7500+6	143.9490+3	223.5490+3	54.2135+3	192.7140+3	125.6470+3	51.1761+3	163.3700+3	58.757+3	161.1930+3
2.0000+6	124.8000+3	188.5900+3	54.0615+3	163.4840+3	110.7330+3	47.7051+3	160.3110+3	51.2767+3	144.2240+3
2.5000+6	164.3660+3	154.6640+3	48.4694+3	134.0940+3	94.7543+3	43.7579+3	134.0250+3	40.1718+3	122.8640+3
3.0000+6	84.3171+3	123.8520+3	41.3171+3	108.7510+3	78.8887+3	38.4225+3	110.7320+3	69.2863+3	101.8400+3
4.0000+6	44.5690+3	63.8806+3	23.2868+3	58.0493+3	43.5088+3	22.4845+3	61.0946+3	41.3660+3	56.2255+3
6.0000+6	5.0463+3	7.0515+3	2.7246+3	6.5492+3	5.0188+3	2.7111+3	6.9703+3	4.9694+3	6.4662+3
8.0000+6									

TABLE A2 - 5  
NUCLEUS ... 43-TC= 99

PARAMETERS		CROSS SECTION(BARN) AND MU-BAR					
		ENERGY(EV)	TOTAL	ELASTIC	INELASTIC	CAPTURE	MU-BAR
NEUTRON SEPARATION ENERGY	6.641E 00(MEV)						
LEVEL. PARAMETER(XI-ZERO)	4.598E 02						
LEVEL SPACING .....	2.600E 01(MEV)	100.0000+0	19.5741+0	6.5741+0		13.0000+0	6.8227-3
LEVEL DENSITY PARAMETER ..	1.334E 01(1/MEV)	300.0000+0	17.7781+0	6.5880+0		7.1900+0	6.9063-3
PAIRING ENERGY .....	1.334E 01(MEV) TAG.	1.0000+3	10.3363+0	6.4863+0		3.8500+0	7.3122-3
NORMALIZATION FACTOR .....	1.186E 03(1/MEV) TAG.	3.0000+3	8.7945+0	6.3845+0		2.4100+0	6.7832-3
TANGENCY POINT .....	5.305E 00(MEV) TAG.	10.0000+3	8.2855+0	6.5785+0		1.6700+0	14.9807-3
ADOPTED LEVELS (MEV)							
1, GROUND	9/2+	182.9150+0	9.3652+0	8.7016+0	399.3500+0	264.1952+3	189.3555-3
2,	0.14051	7/2+	200.0000+3	9.3839+0	8.5680+0	370.9340+3	245.0000+3
3,	0.14243	1/2-	300.0000+3	9.1236+0	7.8731+0	1.0675+0	183.0000+3
4,	0.18107	5/2+	400.0000+3	8.7603+0	7.4551+0	1.1402+0	165.0000+3
5,	0.5991	3/2-	500.0000+3	8.3791+0	7.1102+0	1.1079+0	161.0000+3
6,	0.5343	5/2-	514.2870+3	8.3263+0	7.0827+0	1.1019+0	160.8511+3
7,	0.6719	5/2-	539.7440+3	8.2323+0	6.9806+0	1.0910+0	160.5787+3
8,	0.7263	7/2+	600.0000+3	8.0096+0	6.7845+0	1.0655+0	160.0000+3
9,	0.7616	5/2+	678.3420+3	7.7363+0	6.5410+0	1.0333+0	151.5902+3
10,	0.9205	3/2+	700.0000+3	7.6607+0	6.4743+0	1.0245+0	162.0000+3
11,	1.0040	3/2-	733.7000+3	7.5512+0	6.3623+0	1.0262+0	162.7015+3
12,	1.0729	5/2-	769.3600+3	7.4352+0	6.2348+0	1.0280+0	163.4125+3
13,	1.1293	1/2-	800.0000+3	7.3356+0	6.1420+0	1.0296+0	164.0000+3
14,	1.1420	3/2-	900.0000+3	7.0340+0	6.0850+0	1.0619+0	167.0000+3
15,	1.199	3/2-	929.8790+3	6.9506+0	5.7177+0	1.0648+0	168.2298+3
			1.0000+6	6.7550+0	5.5126+0	1.0714+0	473.9450+3
			1.0424+6	6.7200+0	5.4773+0	1.0720+0	171.1884+3
			1.0438+6	6.5514+0	5.3045+0	1.0746+0	172.0763+3
			1.1084+6	6.4125+0	5.1631+0	1.0767+0	172.7648+3
			1.1536+6	6.3813+0	5.1313+0	1.0771+0	172.9135+3
			1.2112+6	6.2413+0	4.9885+0	1.0793+0	173.5731+3
			1.2222+6	6.2143+0	4.9609+0	1.0797+0	173.6967+3
			1.2500+6	6.1470+0	4.8923+0	1.0807+0	174.0000+3
			1.5000+6	5.6473+0	4.1465+0	1.0606+0	75.8000+3
			1.7500+6	5.2349+0	3.5693+0	1.6237+0	41.9000+3
			2.0000+6	4.8517+0	3.1235+0	1.7380+0	30.3000+3
			2.5000+6	4.3661+0	2.5164+0	1.8307+0	19.0000+3
			3.0000+6	4.0143+0	2.1895+0	1.8421+0	13.8000+3
			4.0000+6	3.7373+0	1.8951+0	1.8347+0	7.5100+3
			6.0000+6	4.0511+0	2.1749+0	1.8738+0	2.3600+3
			8.0000+6	4.3470+0	2.5667+0	1.7796+0	680.0000+6
			10.0000+6	4.4425+0	2.7208+0	1.7215+0	240.0000+6
			11.0000+6	4.4523+0	2.7180+0	1.7341+0	160.0000+6
			12.0000+6	4.4966+0	2.6789+0	1.7677+0	110.0000+6
			15.0000+6	4.2543+0	2.4315+0	1.8228+0	30.0000+6

## CROSS SECTION FOR EXCITATION OF LEVELS

ENERGY(EV)	1-ST	2-ND	3-TH	4-TH	5-TH	6-TH	7-TH	8-TH	9-TH
141.9420+3	0.0 +0								
144.0830+3	19.3331-3	0.0 +0							
182.9150+3	369.9836-3	2.3015-3	0.0 +0						
200.0000+3	524.2600-3	3.3341-3	43.3397-3						
300.0000+3	819.3710-3	7.3354-3	240.8040-3						
400.0000+3	845.8350-3	12.2932-3	287.0680-3						
500.0000+3	808.2340-3	17.9743-3	281.7180-3						
514.2870+3	799.5777-3	18.2948-3	279.8701-3	0.0 +0					
539.7440+3	784.1533-3	18.8658-3	276.5775-3	818.0170-6	0.0 +0				
600.0000+3	747.6450-3	20.2173-3	268.7840-3	2.7542-3	26.1001-3				
678.3420+3	702.2826-3	21.24n1-3	257.9415-3	4.7610-3	43.0206-3	0.0 +0			
700.0000+3	21.5728-3	254.9440-3	5.3156-3	47.6983-3	5.2277-3				
733.7000+3	663.5558-3	21.8800-3	246.8092-3	5.8548-3	47.5530-3	11.2595-3	0.0 +0		
769.3600+3	635.8465-3	22.2580-3	238.2012-3	6.4251-3	47.3992-3	17.6420-3	41.2913-3	0.0 +0	
800.0000+3	612.0380-3	22.5428-3	230.8050-3	6.9151-3	47.2671-3	23.1261-3	76.7699-3	10.0947-3	
900.0000+3	526.0500-3	24.0476-3	196.5580-3	8.5119-3	47.4303-3	31.4721-3	175.3890-3	50.4081-3	
929.8790+3	509.8642-3	24.6164-3	192.7181-3	9.0395-3	47.9051-3	32.9239-3	189.1970-3	56.8179-3	0.0 +0
1.0000+6	471.8790-3	25.9043-3	179.2240-3	10.2729-3	49.0195-3	36.3310-3	221.6020-3	71.8606-3	5.3194-3
1.0424+6	468.1439-3	26.0411-3	178.2059-3	10.4857-3	49.1849-3	36.6084-3	222.9500-3	72.7001-3	6.0695-3
1.0838+6	449.8750-3	26.8495-3	173.2265-3	11.5264-3	49.9938-3	37.9676-3	229.3431-3	76.8064-3	9.7386-3
1.1408+6	434.9186-3	27.6538-3	169.1499-3	12.37n3-3	50.6561-3	39.0799-3	234.9407-3	80.1681-3	12.7424-3
1.1536+6	431.5510-3	27.8132-3	168.2320-3	12.5702-3	50.8052-3	39.3304-3	236.1560-3	80.9251-3	13.4188-3
1.2127+6	416.4371-3	28.3287-3	168.1125-3	13.4311-3	51.4744-3	40.4245-3	241.6105-3	84.3222-3	16.4342-3
1.2223+6	413.5260-3	28.6667-3	167.3176-3	13.5397-3	51.6035-3	40.6714-3	242.6629-3	84.9776-3	17.0399-3
1.2500+6	406.2580-3	29.0105-3	161.3380-3	14.0110-3	51.9251-3	41.2116-3	245.2840-3	86.6101-3	18.4986-3
1.5000+6	323.7680-3	28.2360-3	145.5890-3	16.2156-3	50.0005-3	41.5614-3	217.5560-3	86.5878-3	23.3310-3
1.7500+6	233.7440-3	25.6392-3	117.7190-3	16.6871-3	44.0899-3	37.9504-3	165.7570-3	75.2325-3	24.0289-3
2.0000+6	169.3180-3	22.9906-3	92.7205-3	16.2793-3	38.3094-3	33.8019-3	124.4320-3	62.8171-3	22.8962-3
2.5000+6	90.6557-3	17.6189-3	55.1961-3	13.8747-3	28.0838-3	25.6582-3	71.7704-3	41.6982-3	18.2694-3
3.0000+6	47.6192-3	12.5390-3	30.8621-3	10.5000-3	19.3241-3	18.1152-3	40.2821-3	25.3767-3	12.5127-3
4.0000+6	13.6169-3	5.5677-3	9.4874-3	4.9407-3	8.1015-3	7.7787-3	11.9684-3	8.2019-3	4.5861-3
6.0000+6	1.4654-3	676.3770-6	1.0819-3	639.4969-6	967.6010-6	947.2870-6	1.2977-3	951.7780-6	587.1840-6
8.0000+6									
10.0000+6									
11.0000+6									
12.0000+6									
13.0000+6									

TABLE A2 - 6  
NUCLEUS ... 44-MU-101

PARAMETERS		CROSS SECTION(BARN) AND MU-BAR								
		ENERGY(EV)	TOTAL	ELASTIC	INELASTIC	CAPTURE	MU-BAR			
NEUTRON SEPARATION ENERGY	9.216E 00(MEV)									
LEVEL SPACING(X1=ZERO)	1.592E 02	100.0000+0	19.1232+0	6.0232+0	13.1000+0	6.6969-3				
LEVEL SPACING .....	1.500E 01(MEV)	300.0000+0	13.4863+0	6.0005+0	7.4600+0	6.8099-3				
LEVEL DENSITY PARAMETER ..	1.392E 01(1/MEV)	1.0000+3	10.1377+0	5.9677+0	4.1500+0	7.3467-3				
1.464E 01(1/MEV)	COM.	5.0000+3	8.6533+0	5.9533+0	2.7000+0	9.2387-3				
PAIRING ENERGY .....	1.280E 00(MEV)	10.0000+3	8.1542+0	6.1242+0	2.0300+0	16.8695-3				
Z+22DE	00(MEV)									
NORMALIZATION FACTOR .....	1.263E 03(1/MEV)	20.0000+3	8.2801+0	6.5901+0	1.6900+0	28.5021-3				
TANGENCY POINT .....	5.265E 00(MEV)	50.0000+3	8.7827+0	7.6727+0	1.1100+0	63.8884-3				
6.191E 00(MEV)	COM.	100.0000+3	9.2113+0	8.4983+0	713.0000+3	118.9270-3				
128.3690+3		9.2394+0	8.6543+0	0.0 +0	585.1532+3	148.2163-3				
200.0000+3		9.3104+0	8.3242+0	574.2160+3	412.0000+3	222.1710-3				
ADOPTED LEVELS (MEV)										
1.	GROUND	5/2+	300.0000+3	9.6015+0	7.8513+0	850.1910+3	320.0000-3	300.3980-3		
2.	0+1273	3/2+	309.7430+3	9.0282+0	7.7587+0	926.0120+3	303.5183+3	309.3980-3		
3.	0+3067	7/2+	314.3080+3	9.0127+0	7.7549+0	961.4740+3	296.3054+3	313.4554+3		
4.	0+3112	5/2+	328.6500+3	8.9639+0	7.6147+0	1.0739+0	275.2597+3	326.5449+3		
5.	0.3254	1/2+	400.0000+3	8.7209+0	6.8753+0	1.6466+0	199.0000+3	391.6610+3		
6.	0+4224	3/2+	426.6160+3	8.6256+0	6.7255+0	1.7146+0	186.1766+3	407.8117+3		
7.	0+528	11/2-	500.0000+3	8.3554+0	6.3038+0	1.9035+0	158.0000+3	492.3370-3		
8.	0+5447	7/2+	533.2730+3	8.2504+0	6.1784+0	1.9266+0	145.4466+3	465.5587+3		
9.	0+6161	7/2+	550.1600+3	8.1924+0	6.1141+0	1.9383+0	139.7417+3	472.2611+3		
10.	0+6742	3/2+	600.0000+3	8.0199+0	5.9219+0	1.9730+0	125.0000+3	492.0740+3		
11.	0+720	7/2+	622.2530+3	7.9471+0	5.8511+0	1.9763+0	119.6850+3	498.3402-3		
12.	0+8426	7/2+	680.9330+3	7.7551+0	5.6651+0	1.9851+0	107.4839+3	514.8639-3		
13.	0+9111	7/2+	700.0000+3	7.6927+0	5.6004+0	1.9879+0	104.0000+3	520.2330-3		
14.	0+9282	9/2+	727.1900+3	7.6693+0	5.5244+0	1.9841+0	100.8579+3	525.6242+3		
15.	0+9381	7/2+	800.0000+3	7.3861+0	5.3188+0	1.9739+0	93.4000+3	540.0610+3		
16.	1+0011	11/2+	851.0150+3	7.2401+0	5.1946+0	1.9546+0	91.0642+3	546.5027-3		
900.0000+3		7.1000+0	5.0749+0	1.9360+0	89.0000+3	552.6880-3				
920.1990+3		7.0461+0	5.0273+0	1.9314+0	87.4098+3	554.6501+3				
937.4700+3		7.0001+0	4.9865+0	1.9275+0	86.0995+3	556.3278+3				
947.4690+3		6.9735+0	4.9629+0	1.9252+0	85.3607+3	557.2591+3				
1.	0.0000+6		6.8335+0	4.8386+0	1.9132+0	81.7000+3	562.4020-3			
1.	0.1111+6		6.8074+0	4.8156+0	1.9114+0	80.4084+3	562.9373-3			
1.	0.6055+6		6.5944+0	4.7126+0	1.9037+0	75.0986+3	565.3188-3			
1.	1.2500+6		6.2461+0	4.3135+0	1.8735+0	59.7200+3	574.4570-3			
1.	1.8000+6		5.7533+0	3.8570+0	1.8486+0	46.8000+3	576.6620-3			
1.	1.7500+6		5.3400+0	3.4597+0	1.8363+0	44.0000+3	574.2620-3			
2.	0.0000+6		4.9880+0	3.1175+0	1.8292+0	40.9000+3	569.9540+3			
2.	500000+6		4.4346+0	2.5689+0	1.8116+0	34.1000+3	560.2290+3			
3.	0.0000+6		4.0572+0	2.2382+0	1.7905+0	28.5000+3	552.1380+3			
4.	0.0000+6		3.7533+0	1.9297+0	1.8061+0	17.5000+3	554.0300+3			
6.	0.0000+6		4.0468+0	2.1562+0	1.8652+0	5.3900+3	667.7400+3			
8.	0.0000+6		4.3394+0	2.5505+0	1.7874+0	1.4600+3	776.1640+3			
10.	0.0000+6		4.4680+0	2.7240+0	1.7426+0	50.0000+6	832.0270+3			
11.	0.0000+6		4.4982+0	2.7342+0	1.7637+0	320.0000+6	848.6230+3			
12.	0.0000+6		4.5083+0	2.7067+0	1.8013+0	220.0000+6	860.2280+3			
15.	0.0000+6		4.3079+0	2.4752+0	1.8327+0	60.0000+6	875.2730+3			
CROSS SECTION FOR EXCITATION OF LEVELS										
ENERGY(EV)	1-ST	2-ND	3-TH	4-TH	5-TH	6-TH	7-TH	8-TH	9-TH	
128.3690+3	0.0 +0									
200.0000+3	574.2160+3									
300.0000+3	850.1510+3									
309.7630+3	835.2630+3	0.0 +0								
314.3080+3	828.3322+3	73.8143+3	0.0 +0							
328.6500+3	806.4615+3	98.9616+3	68.0780+3	0.0 +0						
400.0000+3	697.6570+3	472.8120+3	527.8590+3	69.3325+3						
426.6180+3	650.3374+3	511.4113+3	443.4583+3	80.0938+3	0.0 +0					
500.0000+3	519.8840+3	617.8240+3	544.6330+3	109.7610+3	111.4250+3					
533.2730+3	484.0703+3	607.7812+3	539.0488+3	110.7589+3	139.5793+3	0.0 +0				
550.1400+3	465.9153+3	602.6903+3	536.2180+3	111.2647+3	153.8515+3	10.9608+3	0.0 +0			
600.0000+3	417.2860+3	587.6410+3	527.8560+3	112.7600+3	196.0410+3	43.3163+3	93.1228+3			
622.2530+3	394.7060+3	564.8136+3	510.5468+3	111.3000+3	199.4373+3	47.0871+3	121.9113+3	0.0 +0		
680.9330+3	348.4510+3	504.6191+3	464.9189+3	107.4500+3	108.3930+3	56.9112+3	197.8252+3	81.2812+3	0.0 +0	
700.0000+3	333.4210+3	485.0600+3	450.0930+3	106.1900+3	211.3030+3	60.1030+3	222.4920+3	107.6920+3	111.5611+3	
727.1900+3	316.1097+3	459.7206+3	428.2616+3	102.9563+3	236.9344+3	62.9914+3	230.3580+3	129.1577+3	28.3140+3	
800.0000+3	294.7530+3	391.8660+3	364.8010+3	94.2779+3	195.2360+3	70.7752+3	146.4078+3	146.6330+3	13.1754+3	
851.0150+3	244.8710+3	329.0751+3	340.4062+3	89.7681+3	186.0798+3	74.7953+3	247.4090+3	197.0241+3	88.8899+3	
900.0000+3	228.8200+3	327.4910+3	317.1810+3	85.4425+3	177.2880+3	78.7113+3	243.5760+3	206.9980+3	103.9790+3	
920.1990+3	222.5240+3	315.3874+3	301.9217+3	84.0718+3	173.6320+3	78.2110+3	237.7048+3	204.2457+3	105.7179+3	
937.4700+3	217.1421+3	305.0382+3	293.1496+3	82.8997+3	170.5026+3	77.7823+3	232.6842+3	201.8941+3	107.2048+3	
947.4690+3	214.0298+3	299.0466+3	282.0710+3	82.2212+3	168.6418+3	77.5346+3	229.7753+3	20.5326+3	108.0585+3	
1.	0.0000+6	197.6540+3	267.3560+3	261.3900+3	78.5963+3	159.1790+3	76.2345+3	214.5160+3	193.3800+3	112.5880+3
1.	0.1111+6	195.64420+3	263.9485+3	248.1684+3	137.1821+3	157.8216+3	75.6234+3	212.1413+3	191.5803+3	112.3510+3
1.	0.0605+6	184.6894+3	247.8310+3	245.8339+3	75.9849+3	151.7848+3	77.9042+3	201.5661+3	183.5724+3	111.2964+3
1.2500+6	152.3390+3	146.0270+3	184.8320+3	67.6158+3	128.6070+3	62.4706+3	160.9890+3	152.8460+3	107.2500+3	
1.5000+6	174.7940+3	157.3376+3	156.5470+3	99.0055+3	110.8740+3	47.7078+3	139.5210+3	134.3420+3	97.0335+3	
1.7500+6	114.6800+3	143.8010+3	139.5210+3	55.0600+3	100.3620+3	40.3680+3	126.6610+3	124.3630+3	89.1000+3	
2.0000+6	104.2670+3	134.0750+3	127.5500+3	29.1094+3	29.5040+3	36.6337+3	120.9740+3	117.1550+3	82.7120+3	
2.2500+6	84.8145+3	113.6310+3	106.0700+3	42.9994+3	77.9813+3	32.0504+3	105.3310+3	102.6940+3	71.4136+3	
3.0000+6	55.9061+3	40.2355+3	83.9668+3	34.2784+3	62.5821+3	24.1022+3	86.0319+3	84.6205+3	59.0977+3	
4.0000+6	33.4874+3	46.0374+3	43.1177+3	17.9174+3	32.8469+3	10.6976+3	45.2092+3	44.9329+3	32.1751+3	
6.0000+6	3.2553+3	4.5101+3	4.2162+3	1.7592+3	3.2229+3	3.9185+3	4.4720+3	4.4605+3	3.2070+3	
8.0000+6										
10.0000+6										
11.0000+6										
12.0000+6										
13.0000+6										

JAERI-M 5752

TABLE A2 -

NUCLEUS ... 44-RU-102

## PARAMETERS

CROSS SECTIONS (BARN) AND MU-RATE

			ENERGY(EV)	TOTAL	ELASTIC	INELASTIC	CAPTURE	MU-BAR
NEUTRON SEPARATION ENERGY	6.243E-00(MEV)							
LEVEL PARAMETER(XI=ZERO)	3.979E-02	ABOVE 0.2MEV	100.00000+0	18.9810+0	12.0910+0	6.8900+0	6.6296+3	
	9.447E-02	BELLOW 0.2MEV	300.00000+0	13.3805+0	10.2705+0	3.1100+0	6.7467+3	
LEVEL SPACING .....	2.500E-02(MEV)	ABOVE 0.2MEV	1.00000+3	10.0643+0	8.5943+0	1.4700+0	7.3209+3	
	6.250E-02	BELLOW 0.2MEV	3.00000+3	8.5946+0	7.6166+0	978.0000-3	9.3612+3	
LEVEL DENSITY PARAMETER ..	1.464E-01(1/MEV)	TAG.	10.00000+3	8.0525+0	7.8852+0	620.0000-3	17.5528+3	
PAIRING ENERGY .....	2.202E-00(MEV)	TAG.	20.00000+3	8.2340+0	7.8020+0	432.0000-3	29.9667+3	
	1.240E-00(MEV)	COM.	50.00000+3	8.7341+0	8.4691+0	265.0000-3	66.9661+3	
NORMALIZATION FACTOR .....	1.341E-03(1/MEV)	TAG.	100.00000+3	9.1565+0	8.9546+0	200.0000-3	123.4780+3	
TANGENCY POINT .....	6.161E-00(MEV)	TAG.	200.00000+3	9.2498+0	9.0874+0	162.0000-3	212.9390+3	
	5.236E-00(MEV)	COM.	300.00000+3	9.0996+0	8.8516+0	158.0000-3	275.6920+3	
ADOPTED LEVELS (MEV)			400.00000+3	8.6524+0	8.5104+0	172.0000-3	319.3770+3	
			479.59600+3	8.4107+0	8.7618+0	148.8574+3	351.9763+3	
			500.00000+3	8.3400+0	7.9611+0	239.9370+3	144.0000-3	360.3330+3
1.	GROUND	0+	600.00000+3	8.0088+0	6.9519+0	96.4580+3	96.4000+0	422.7110+3
2.	0.4749	2+	700.00000+3	7.6932+0	6.3956+0	1.2098+0	87.8000+3	459.1410+3
3.	0.9437	0+						
4.	1.1032	2+	800.00000+3	7.3965+0	6.0209+0	1.2879+0	87.8000+3	484.9510+3
5.	1.1066	4+	900.00000+3	7.1186+0	5.7172+0	1.3100+0	91.0000+0	414.1290+3
6.	1.5214	3+	953.03700+3	6.9811+0	5.5537+0	1.3349+0	93.3390+3	500.9241+3
7.	1.5808	2+	1.00000+6	6.8592+0	5.4072+0	1.3569+0	95.2000+3	506.9610+3
8.	1.7590	4+	1.1141+6	6.5965+0	5.0641+0	1.4409+0	91.4400+0	520.9595+3
9.	1.8371	0+						
10.	1.8732	6+	1.1175+6	6.5866+0	5.0530+0	1.4435+0	91.3360+3	521.3766+3
11.	2.0375	7+	1.2500+6	6.2836+0	4.6569+0	1.5611+0	87.6000+3	535.6220+3
12.	2.0441	3-	1.5000+6	5.7972+0	4.1087+0	1.6013+0	91.2000+3	549.5080+3
13.	2.2192	5+	1.5349+6	5.7360+0	4.0369+0	1.6101+0	91.0255+3	549.8893+3
14.	2.2613	2+	1.5964+6	5.6375+0	3.9224+0	1.6243+0	90.7538+3	551.0688+3
15.	2.3772	5-						
			1.7500+6	5.3831+0	3.6320+0	1.6609+0	90.1000+3	555.1470+3
			1.8168+6	5.2882+0	3.5273+0	1.6699+0	91.0410+3	555.8165+3
			1.8553+6	5.2355+0	3.4669+0	1.6750+0	91.5719+3	556.2022+3
			1.8917+6	5.1812+0	3.4098+0	1.6799+0	92.0674+3	556.5676+3
			2.0000+6	5.0280+0	3.2401+0	1.6943+0	93.5000+3	557.6530+3
			2.0577+6	4.9629+0	3.1711+0	1.7000+0	91.8643+3	557.9037+3
			2.0643+6	4.9554+0	3.1631+0	1.7007+0	91.6801+3	557.9326+3
			2.2412+6	4.7561+0	2.9590+0	1.7151+0	87.1176+3	558.7015+3
			2.2837+6	4.7081+0	2.8997+0	1.7223+0	86.1068+3	558.8864+3
			2.3955+6	4.5821+0	2.7652+0	1.7334+0	83.5884+3	559.3725+3
			2.4237+6	4.5502+0	2.7311+0	1.7362+0	82.9815+3	559.4954+3
			2.5000+6	4.4642+0	2.6391+0	1.7437+0	81.4000+3	559.8270+3
			3.0000+6	4.0772+0	2.2488+0	1.7695+0	58.9000+3	558.5030+3
			4.0000+6	3.7639+0	1.9200+0	1.8130+0	30.9000+3	559.1610+3
			6.0000+6	4.0464+0	2.1461+0	1.8921+0	8.1300+0	667.3910+3
			8.0000+6	4.3370+0	2.5434+0	1.7917+0	1.8400+3	774.9790+3
			10.0000+6	4.4805+0	2.7265+0	1.7550+0	520.0000+6	831.2740+3
			11.0000+6	4.5194+0	2.7412+0	1.7778+0	310.0000+6	88.2100+3
			12.0000+6	4.5354+0	2.7187+0	1.8165+0	200.0000+6	860.1500+3
			15.0000+6	4.3298+0	2.4936+0	1.8362+0	50.0000+6	875.9130+3

CROSS SECTION FOR EXCITATION OF LEVELS

TABLE A2 - 8

NUCLEUS ... 44-RU-104

## PARAMETERS

## CROSS SECTION(BARN) AND MU-BAR

	ENERGY(EV)	TOTAL	ELASTIC	INELASTIC	CAPTURE	MU-BAR
NEUTRON SEPARATION ENERGY	5.981E 00(MEV)					
LEVEL PARAMETR(X1=2.00)	1.500E 03	100.0000+0	14.8676+0	13.3474+0	5.5200+0	6.5124+3
LEVEL SPACING .....	9.475E 02(MEV)	300.0000+0	13.2645+0	10.8586+0	2.4100+0	6.6614+3
LEVEL DENSITY PARAMETR ..	1.601E 01(1/MEV)	1.0000+3	9.9459+0	8.7739+0	1.1700+0	7.3779+3
PAIRING ENERGY .....	1.666E 01(1/MEV)	1.666E 01(1/MEV)	3.0000+3	8.4729+0	7.6859+0	787.0000+3
PAIRING ENERGY .....	2.520E 00(MEV)	TAG.	10.0000+3	7.9475+0	7.9475+0	9.8776+3
PAIRING ENERGY .....	1.240E 00(MEV)	COM.				426.0000+3
NORMALIZATION FACTOR .....	1.495E 03(1/MEV)	TAG.	20.0000+3	8.0947+0	7.8457+0	245.0000+3
TANGENCY POINT .....	6.442E 00(MEV)	TAG.	50.0000+3	8.2685+0	8.4535+0	115.0000+3
TANGENCY POINT .....	5.209E 00(MEV)	COM.	100.0000+3	8.9601+0	8.8875+0	72.6000+3
ADOPTED LEVELS (MEV)		200.0000+3	9.0485+0	8.9842+0	64.3000+3	135.2930+3
		300.0000+3	8.8372+0	8.7647+0	72.5000+3	289.1460+3
1. GROUND	0+	361.4720+3	8.6607+0	8.6155+0	0.0 +0	45.2285+3
2. 0.358	2+	400.0000+3	8.5501+0	8.0501+0	465.0220+3	35.0000+3
3. 0.889	2+	500.0000+3	8.2497+0	7.0867+0	1.1377+0	25.3000+3
4. 0.893	4+	600.0000+3	7.9549+0	6.6077+0	1.3235+0	23.7000+3
5. 0.893	0+	700.0000+3	7.6724+0	6.2799+0	1.3684+0	24.1000+3
		800.0000+3	7.4040+0	6.0058+0	1.3727+0	25.5000+3
		897.6220+3	7.1562+0	5.7590+0	1.3702+0	27.0630+3
		900.0000+3	7.1502+0	5.7530+0	1.3701+0	27.1000+3
		901.6610+3	7.1462+0	5.7474+0	1.3718+0	27.0365+3
		992.5340+3	6.9285+0	5.4424+0	1.4622+0	24.0208+3
		1.0000+6	6.9107+0	5.4173+0	1.4696+0	23.8000+3
		1.2500+6	6.3687+0	4.7172+0	1.6306+0	20.9000+3
		1.4136+6	6.0806+0	4.3233+0	1.7172+0	20.1515+3
		1.5000+6	5.8979+0	4.1151+0	1.7630+0	19.8000+3
		1.7500+6	5.4856+0	3.6936+0	1.7720+0	20.0000+3
		2.0000+6	5.1236+0	3.3293+0	1.7741+0	20.2000+3
		2.5000+6	4.5364+0	2.7546+0	1.7625+0	19.2000+3
		3.0000+6	4.1285+0	2.3612+0	1.7501+0	17.2000+3
		4.0000+6	3.7959+0	1.9953+0	1.7898+0	10.8000+3
		6.0000+6	4.0444+0	2.1811+0	1.8606+0	2.7100+3
		8.0000+6	4.3301+0	2.5235+0	1.8060+0	510.0000+6
		10.0000+6	4.5127+0	2.1291+0	1.7835+0	120.0000+6
		11.0000+6	4.5729+0	2.7577+0	1.8151+0	70.0000+6
		12.0000+6	4.6011+0	2.7479+0	1.8532+0	40.0000+6
		15.0000+6	4.3788+0	2.5377+0	1.8411+0	10.0000+6

## CROSS SECTION FOR EXCITATION OF LEVELS

ENERGY(EV)	1-ST	2-ND	3-TH	4-TH
361.4720+3	0.0 +0			
400.0000+3	465.0220+3			
500.0000+3	1.1377+0			
600.0000+3	1.3235+0			
700.0000+3	1.3684+0			
800.0000+3	1.3727+0			
897.6220+3	1.3619+0	0.0 +0		
900.0000+3	1.3607+0	9.4193+3		
901.6610+3	1.3569+0	13.9042+3	0.0 +0	
992.5340+3	1.1488+0	259.2766+3	43.0229+3	0.0 +0
1.0000+6	1.1317+0	279.4360+3	46.5576+3	11.9302+3
1.2500+6	116.9230+3	496.2440+3	114.9890+3	202.0390+3
1.4136+6	651.9028+3	653.8761+3	131.9738+3	192.0717+3
1.5000+6	564.7220+3	446.7760+3	140.9470+3	166.8060+3
1.7500+6	531.9580+3	440.2916+3	169.1900+3	170.0570+3
2.0000+6	508.4690+3	427.4290+3	190.8680+3	151.5040+3
2.5000+6	453.4620+3	399.9350+3	217.5980+3	125.1350+3
3.0000+6	393.7680+3	361.5600+3	225.8160+3	109.3200+3
4.0000+6	302.7740+3	295.7490+3	215.0100+3	86.8974+3
6.0000+6	210.6510+3	210.0230+3	195.9280+3	58.0784+3
8.0000+6				
10.0000+6				
11.0000+6				
12.0000+6				
15.0000+6				

TABLE A2 - 9  
NUCLEUS ... 44-RU-106

PARAMETERS	CROSS SECTION(BARNS) AND MU-BAR					
	ENERGY(EV)	TOTAL	ELASTIC	INELASTIC	CAPTURE	MU-BAR
NEUTRON SEPARATION ENERGY 5.441E-00(MEV)	100.0000+0	19.0173+0	14.5573+0		4.4600+0	6.3975+3
LEVEL PARAMETER(X=ZE90) 2.122E-03	300.0000+0	13.3020+0	11.3920+0		1.9100+0	6.5706+3
LEVEL SPACING ..... 1.000E-03(MEV)						
LEVEL DENSITY PARAMETER 1.70AE-01(1/MEV) TAG.	1.0000+3	9.9098+0	8.9588+0		954.0000+3	7.3974+3
1.746E-01(1/MEV) COM.	3.0000+3	8.3924+0	7.7534+0		639.0000+3	10.2596+3
PAIRING ENERGY ..... 2.530E-00(MEV) TAG.	10.0000+3	7.8537+0	7.5347+0		319.0000+3	21.2443+3
1.280E-00(MEV) COM.						
NORMALIZATION FACTOR 1.626E-03(1/MEV) TAG.	20.0000+3	7.9455+0	7.7615+0		181.0000+3	37.0222+3
50.0000+3	8.3742+0	8.2905+0			83.7000+3	81.4087+3
TANGENCY POINT ..... 6.445E-00(MEV) TAG.	8.0000+3	8.7314+0	8.6758+0		55.6000+3	144.7120+3
5.182E-00(MEV) COM.	200.0000+3	8.8173+0	8.7643+0		53.0000+3	238.0260+3
272.5690+3	8.6876+0	8.6568+0	0.0 +0		30.8599+3	292.4499+3
ADOPTED LEVELS (MEV)						
1. GROUND 0+	300.0000+3	8.6386+0	8.2380+0	374.5420+3	26.1000+3	313.0220+3
2. 0.270 2+	400.0000+3	8.3929+0	7.1957+0	1.1801+0	17.1000+3	395.7470+3
3. 0.711 4+	500.0000+3	8.1232+0	6.7469+0	1.3706+0	15.8000+3	442.0680+3
4. 0.791 2+	600.0000+3	7.8757+0	6.4568+0	1.4029+0	15.9000+3	469.7980+3
5. 0.989 0+	700.0000+3	7.6257+0	6.2139+0	1.3950+0	16.8000+3	487.6560+3
6. 1.772 2+	717.7660+3	7.5830+0	6.1732+0	1.3490+0	16.8187+3	489.8457+3
7. 1.888 2+	728.5270+3	7.3889+0	5.9881+0	1.3839+0	16.8966+3	499.7995+3
	800.0000+3	7.3853+0	5.9847+0	1.3837+0	16.9000+3	499.9810+3
	900.0000+3	7.1551+0	5.6720+0	1.4677+0	15.5000+3	516.8330+3
	998.4110+3	6.9389+0	5.4037+0	1.5197+0	15.4015+3	528.6935+3
	1.0000+6	6.9354+0	5.3994+0	1.5206+0	15.4000+3	528.8850+3
	1.2500+6	6.4275+0	4.7820+0	1.6291+0	16.5000+3	550.6320+3
	1.5000+6	5.9732+0	4.2978+0	1.6558+0	19.6000+3	557.8890+3
	1.7500+6	5.5648+0	3.8735+0	1.6675+0	23.8000+3	560.5530+3
	1.7889+6	5.5080+0	3.8105+0	1.6734+0	24.0871+3	561.4188+3
	1.9000+6	5.3369+0	3.6210+0	1.6910+0	24.9357+3	564.0280+3
	1.9241+6	5.3103+0	3.5915+0	1.6937+0	25.0652+3	564.4328+3
	2.0000+6	5.1994+0	3.4687+0	1.7050+0	25.6000+3	566.1230+3
	2.5000+6	4.5908+0	2.8144+0	1.7645+0	19.0000+3	574.3230+3
	3.0000+6	4.1777+0	2.3868+0	1.7760+0	14.9000+3	569.4630+3
	4.0000+6	3.8334+0	1.9815+0	1.8438+0	H.0400+3	557.3090+3
	6.0000+6	4.0436+0	2.1419+0	1.9000+0	1.6700+3	652.6880+3
	8.0000+6	4.3251+0	2.5052+0	1.8197+0	240.0000+6	768.1220+3
	10.0000+6	4.5426+0	2.7301+0	1.8125+0	60.0000+6	827.1400+3
	11.0000+6	4.6192+0	2.7708+0	1.8484+0	30.0000+6	845.9540+3
	12.0000+6	4.6536+0	2.7714+0	1.8821+0	20.0000+6	859.5970+3
	15.0000+6	4.4159+0	2.5731+0	1.8429+0		878.6330+3
CROSS SECTION FOR EXCITATION OF LEVELS						
ENERGY(EV)	1-ST	2-ND	3-TH	4-TH	5-TH	6-TH
272.5690+3	0.0 +0					
300.0000+3	374.5420+3					
400.0000+3	1.1801+0					
500.0000+3	1.3706+0					
600.0000+3	1.4029+0					
700.0000+3	1.3950+0					
717.7660+3	1.3860+0	0.0 +0				
728.5270+3	1.3453+0	31.4683+3	0.0 +0			
800.0000+3	1.3446+0	32.0423+3	7.0658+3			
900.0000+3	1.1303+0	59.4243+3	277.9900+3			
998.4110+3	999.1331+3	80.1150+3	436.4534+3	0.0 +0		
1.0000+6	947.0160+3	80.4989+3	439.0120+3	4.1202+3		
1.2500+6	793.4640+3	130.9790+3	521.3610+3	183.0940+3		
1.5000+6	738.0590+3	180.4780+3	535.1130+3	202.1240+3		
1.7500+6	712.5770+3	229.6730+3	538.4140+3	190.8740+3		
1.7889+6	697.0738+3	226.8461+3	526.9671+3	185.4247+3	0.0 +0	
1.9060+6	642.3256+3	230.3141+3	497.4702+3	169.0076+3	89.0727+3	0.0 +0
1.9241+6	634.1416+3	236.9299+3	487.1173+3	166.4547+3	102.8926+3	14.3522+3
2.0000+6	599.9730+3	233.2290+3	464.7720+3	155.8170+3	160.5910+3	74.2728+3
2.5000+6	384.4560+3	194.6700+3	375.9850+3	102.0990+3	204.9050+3	188.5590+3
3.0000+6	294.2470+3	174.0140+3	266.8730+3	80.2727+3	192.9770+3	183.6860+3
4.0000+6	198.4930+3	167.4960+3	169.2420+3	56.0787+3	169.5680+3	165.4130+3
6.0000+6	129.8640+3	129.6050+3	124.7110+3	35.1176+3	126.4210+3	126.0530+3
8.0000+6						
10.0000+6						
11.0000+6						
12.0000+6						
13.0000+6						

TABLE A2 - 10  
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NUCLEUS \*\*\* 45-RH-103

PARAMETERS		CROSS SECTION(BARN) AND MU-BAR							
		ENERGY(EV)	TOTAL	ELASTIC	INELASTIC	CAPTURE	MU-BAR		
NEUTRON SEPARATION ENERGY	7.007E 00(MEV)								
LEVEL PARAMETER(XI=ZERO) *	1.230E 02	100.0000*0	18.8705*0	6.6705*0		12.2000*0	6.5739*3		
LEVEL SPACING .....	3.090E 01(MEV)	300.0000*0	13.2922*0	6.5522*0		6.7400*0	6.7127*3		
LEVEL DENSITY PARAMETER ..	1.469E 01(1/MEV)	1.0000*3	9.9865*0	6.3895*0		3.6000*0	7.3725*3		
PAIRING ENERGY .....	1.530E 01(1/MEV)	COM.	3.0000*3	6.5263*0	6.2263*0	2.3000*0	9.6710*3		
PAIRING ENERGY .....	9.400E-01(1/MEV)	AGG.	10.0000*3	8.0389*0	6.3189*0	1.7200*0	18.6965*3		
NORMALIZATION FACTOR ....	1.359E 02(1/MEV)	TAG.	20.0000*3	8.1656*0	6.7656*0	1.4000*0	32.0527*3		
TANGENCY POINT .....	4.896E 00(MEV)	TAG.	40.3917*3	8.4986*0	7.5027*0	0.0 +0	995.8418*3		
	3.942E 00(MEV)	COM.	50.0000*3	8.6555*0	7.7550*0	2.4930*3	898.0000*3		
			93.9107*3	9.0129*0	8.4129*0	9.5055*3	591.1300*3		
			100.0000*3	9.0625*0	8.4849*0	10.5978*3	567.0000*3		
ADOPTED LEVELS (MEV)									
1. GROUND	1/2-	200.0000*3	9.1537*0	8.7589*0	41.7374*3	353.0000*3	221.4050*3		
2. 0.040	7/2+	300.0000*3	8.9272*0	8.5628*0	84.4145*3	280.0000*3	285.6870*3		
3. 0.093	5/2+	300.9180*3	8.9244*0	8.5525*0	93.3654*3	278.4850*3	286.5038*3		
4. 0.198	3/2-	363.5250*3	8.7318*0	7.8185*0	714.2760*3	149.0879*3	342.2062*3		
5. 0.360	7/2-	400.0000*3	8.6197*0	7.3660*0	1.0857*0	168.0000*3	374.6590*3		
6. 0.537	5/2*	500.0000*3	8.2984*0	6.6500*0	1.5304*0	118.0000*3	438.3470*3		
7. 0.651	7/2+	542.2590*3	8.1659*0	6.4817*0	1.5762*0	107.9961*3	454.1121*3		
8. 0.798	5/2*	600.0000*3	7.9848*0	6.2491*0	1.6390*0	96.7000*3	475.6530*3		
9. 0.843	3/2-	657.3750*3	7.8131*0	6.0792*0	1.6439*0	89.9912*3	488.9915*3		
10. 0.877	5/2-	700.0000*3	7.6855*0	5.9523*0	1.6476*0	85.6000*3	498.9010*3		
11. 0.915	5/2-	800.0000*3	7.4029*0	5.6983*0	1.6217*0	82.9000*3	513.8020*3		
		805.8150*3	7.3874*0	5.6827*0	1.6220*0	82.6996*3	514.5681*3		
		851.2590*3	7.2666*0	5.5614*0	1.6240*0	81.1971*3	520.5543*3		
		885.5880*3	7.1753*0	5.4696*0	1.6256*0	80.1312*3	525.0174*3		
		900.0000*3	7.1370*0	5.4315*0	1.6262*0	74.7000*3	526.9760*3		
		923.9600*3	7.0772*0	5.3580*0	1.6121*0	77.1345*3	530.7794*3		
		1.0000*6	6.8875*0	5.1259*0	1.6926*0	66.9000*3	542.8500*3		
		1.1128*6	6.6553*0	4.8563*0	1.7172*0	61.9915*3	551.6761*3		
		1.2500*6	6.3285*0	4.5268*0	1.7473*0	54.4000*3	562.4130*3		
		4.0000*6	3.7846*0	2.2325*0	1.8476*0	23.7000*3	575.3160*3		
		6.0000*6	4.0461*0	2.1340*0	1.9084*0	3.7000*3	666.8580*3		
		8.0000*6	4.3341*0	2.5340*0	1.7992*0	960.0000*6	773.3430*3		
		10.0000*6	4.4972*0	2.7283*0	1.7685*0	320.0000*6	830.2500*3		
		11.5000*6	4.5471*0	2.7500*0	1.7968*0	210.0000*6	847.6510*3		
		12.0000*6	4.5699*0	2.7390*0	1.8358*0	140.0000*6	860.0350*3		
		15.0000*6	4.3564*0	2.5167*0	1.8396*0	40.0000*6	876.7040*3		
CROSS SECTION FOR EXCITATION OF LEVELS									
ENERGY(EV)	1-ST	2-ND	3-TH	4-TH	5-TH	6-TH	7-TH	8-TH	9-TH
40.3917*3	0.0 +0								
50.0000*3	2.4930*3								
93.9107*3	0.4521*3	0.0 +0							
100.0000*3	1.6171*3	180.7070*6							
200.0000*3	35.2972*3	5.2171*3							
300.0000*3	70.2338*3	14.1807*3							
300.9180*3	70.3480*3	14.2362*3	0.0 +0						
363.5250*3	78.1383*3	18.0198*3	520.3644*3	0.0 +0					
400.0000*3	82.6769*3	20.2241*3	823.5300*3	159.2720*3					
500.0000*3	95.7400*3	24.4315*3	962.4170*3	447.8670*3					
542.2590*3	99.0045*3	26.3051*3	946.2702*3	479.0837*3	0.0 +0				
600.0000*3	103.4650*3	28.8652*3	924.2080*3	521.7370*3	60.6813*3				
657.3750*3	103.1850*3	30.5780*3	887.0732*3	528.4209*3	90.4846*3	0.0 +0			
700.0000*3	102.9770*3	31.8505*3	859.4850*3	533.4040*3	112.6260*3	7.2969*3			
800.0000*3	105.5340*3	35.3494*3	798.1310*3	526.7950*3	132.7900*3	23.1435*3			
805.8150*3	105.5114*3	36.5111*3	792.8812*3	524.7858*3	132.5006*3	23.7364*3	0.0 +0		
851.2590*3	105.3346*3	36.7748*3	751.8575*3	509.0854*3	130.2390*3	28.3694*3	19.9252*3	0.0 +0	
885.5880*3	105.2011*3	37.7296*3	720.8613*3	497.2226*3	128.5303*3	31.8693*3	34.9800*3	49.7780*3	0.0 +0
900.0000*3	105.1450*3	38.1304*3	707.8500*3	492.2430*3	127.8430*3	33.3393*3	41.2946*3	70.6734*3	9.7005*3
923.9600*3	103.9288*3	38.0966*3	672.2591*3	470.0903*3	125.9499*3	34.6727*3	46.7649*3	100.7594*3	33.4309*3
1.0000*6	100.0696*3	37.9893*3	559.3070*3	399.7860*3	120.0370*3	38.9044*3	64.1095*3	196.2410*3	108.7420*3
1.1128*6	100.0469*3	39.8977*3	477.9123*3	351.0937*3	117.5660*3	44.0669*3	73.7920*3	225.5520*3	144.9661*3
1.2500*6	100.0200*3	42.2393*3	378.8950*3	291.8590*3	114.5600*3	50.3516*3	85.5708*3	261.2090*3	189.0330*3
1.5000*6	90.8695*3	42.0464*3	278.9420*3	224.9020*3	99.1279*3	51.9162*3	79.7366*3	222.0280*3	174.2567*3
1.7500*6	78.1681*3	39.1487*3	206.6070*3	180.6880*3	82.9428*3	48.5347*3	68.5770*3	171.0300*3	142.6310*3
2.0000*6	65.1480*3	34.9994*3	152.0900*3	139.7620*3	68.3201*3	43.3282*3	57.6042*3	127.6840*3	112.2710*3
2.5000*6	42.3218*3	25.6119*3	79.5816*3	78.4327*3	44.0164*3	31.3620*3	38.5711*3	68.9934*3	65.8914*3
3.0000*6	25.5834*3	17.1066*3	39.2053*3	40.3754*3	26.1592*3	20.3598*3	23.7038*3	35.4115*3	35.7282*3
4.0000*6	8.5985*3	6.7165*3	9.1039*3	9.9918*3	8.7330*3	7.3401*3	7.7397*3	8.5191*3	9.2400*3
6.0000*6	702.0540*6	624.6916*6	570.3149*6	684.5100*6	635.4561*6	652.4140*6	615.6380*6	534.1649*6	638.5699*6
8.0000*6									
10.0000*6									
11.0000*6									
12.0000*6									
15.0000*6									

TABLE A2 - 11

NUCLEUS ... 46-PD-102

## PARAMETERS

			ENERGY(EV)	TOTAL	ELASTIC	INELASTIC	CAPTURE	MU-BAR
NEUTRON SEPARATION ENERGY	9.551E 00	(MEV)						
LEVEL PARAMETER(XI=ZERO)	1.368E 02		100.0000*0	18.8933*0	5.6933*0		13.2000*0	6.4598*3
LEVEL SPACING .....	1.110E 01	(MEV)	300.0000*0	13.2585*0	5.7186*0		7.5400*0	6.6828*3
LEVEL DENSITY PARAMETER ..	1.516E 01	(1/MEV)	1.0000*3	9.1878*0	5.6987*0		4.2200*0	7.4152*3
PAIRING ENERGY .....	1.593E 01	(1/MEV)	3.0000*3	8.8321*0	5.6721*0		2.7600*0	10.1139*3
PAIRING ENERGY .....	1.350E 00	(MFV)	10.0000*3	7.9210*0	5.8310*0		2.0900*0	20.4760*3
NORMALIZATION FACTOR .....	1.430E 03	(1/MEV)	20.0000*3	8.0299*0	6.2499*0		1.7800*0	35.4546*3
TANGENCY POINT .....	5.279E 00	(MEV)	50.0000*3	8.4856*0	7.2756*0		1.7100*0	78.0813*3
6.505E 00	(MEV)	COM.	100.0000*3	8.8625*0	8.0653*0		796.0000*3	139.7720*3
200.0000*3	8.9695*0	8.4285*0		521.0000*3	223.1930*3			
283.0000*3	8.7856*0	8.3675*0		418.0808*3	286.0903*3			
ADOPTED LEVELS (MEV)					0.0	+0		
1. GROUND	5/2+		300.0000*3	8.7522*0	8.2699*0	79.3416*0	403.0000*3	297.0560*3
2. 0+00	5/2+		309.1410*3	8.7276*0	8.1588*0	186.1440*3	382.6083*3	306.5387*3
3. 0-002	7/2+		322.1650*3	8.6925*0	7.9966*0	339.7170*3	356.2464*3	320.0495*3
4. 0-0121	5/2+		347.7040*3	8.6237*0	7.6658*0	645.7210*3	312.1951*3	346.5473*3
5. 0-0444	7/2+		400.0000*3	8.8430*0	6.9459*0	1-2921*0	425.0000*3	400.7940*3
6. 0-0427	7/2+		446.9530*3	8.3502*0	6.6564*0	1-6825*0	211.3275*3	311.2111*3
7. 0-0800	11/2-		463.6910*3	8.2181*0	6.3537*0	1-6747*0	185.1013*3	461.4934*3
8. 0-0607	3/2+		500.0000*3	8.2003*0	6.3174*0	1-7008*0	182.0000*3	465.5760*3
9. 0-0644	7/2-		546.0800*3	8.0162*0	6.0797*0	1-7445*0	153.7033*3	490.4395*3
10. 0-0506	3/2+		600.0000*3	7.9217*0	5.9670*0	1-8127*0	142.0000*3	503.1900*3
11. 0-6731	7/2+							
12. 0-7271	5/2+		650.5900*3	7.7860*0	5.8302*0	1-8257*0	129.9862*3	515.4696*3
13. 0-78	9/2-		656.8500*3	7.7662*0	5.8132*0	1-8274*0	128.6340*3	516.9880*3
14. 0-0623	5/2+		679.5600*3	7.7082*0	5.7510*0	1-8332*0	123.9457*3	522.4977*3
15. 1.0015	5/2+		700.0000*3	7.6534*0	5.6949*0	1-8353*0	120.0000*3	527.4540*3
			734.0850*3	7.5661*0	5.6085*0	1-8444*0	113.2532*3	533.6343*3
			787.4930*3	7.4292*0	5.4717*0	1.8535*0	103.9750*3	543.3183*3
			800.0000*3	7.3972*0	5.4395*0	1.8557*0	102.0000*3	545.5860*3
			900.0000*3	7.1537*0	5.2226*0	1.8359*0	95.7000*3	556.4460*3
			971.5440*3	6.9885*0	5.0815*0	1.8121*0	94.9094*3	561.0012*3
			1.0000*6	6.9228*0	5.0253*0	1.8027*0	94.8000*3	562.8130*3
			1.0111*6	6.8994*0	5.0038*0	1.8014*0	94.0925*3	563.2641*3
			1.0974*6	6.7174*0	4.8369*0	1.7915*0	89.0129*3	566.7660*3
			1.2500*6	6.3958*0	4.5404*0	1.7739*0	81.5000*3	572.9550*3
			1.5000*6	5.9322*0	4.0965*0	1.7696*0	68.1000*3	576.8690*3
			1.7500*6	5.5217*0	3.6855*0	1.7755*0	60.7000*3	578.7430*3
			2.0000*6	5.1581*0	3.3197*0	1.7833*0	55.1000*3	579.7230*3
			2.5000*6	4.5642*0	2.7287*0	1.7917*0	43.9000*3	579.2910*3
			3.0000*6	4.1505*0	2.3165*0	1.7988*0	35.2000*3	574.9970*3
			4.0000*6	3.8124*0	1.9293*0	1.8626*0	20.5000*3	567.5960*3
			6.0000*6	4.0448*0	2.1171*0	1.9223*0	5.5800*3	664.5510*3
			8.0000*6	4.3285*0	2.5160*0	1.8112*0	1.2500*3	770.1250*3
			10.0000*6	4.5244*0	2.7300*0	1.7960*0	390.0000*6	828.3100*3
			11.0000*6	4.5940*0	2.7639*0	1.8299*0	240.0000*6	846.5940*3
			12.0000*6	4.6255*0	2.7587*0	1.8666*0	160.0000*6	849.7770*3
			15.0000*6	4.3964*0	2.5538*0	1.8425*0	30.0000*6	877.9760*3

## CROSS SECTION FOR EXCITATION OF LEVELS

TABLE A2 - 12

NUCLEUS ... 46-PD=107

PARAMETERS		CROSS SECTION(BARN) AND MU-BAR							
		ENERGY(EV)	TOTAL	ELASTIC	INELASTIC	CAPTURE	MU-BAR		
NEUTRON SEPARATION ENERGY	9.223E 00(MEV)								
LEVEL PARAMETER(XI-ZERO)	1.364E 02								
LEVEL SPACING .....	1.000E 01(MEV)	100.00000+0	19.1441+0	5.5441+0		13.6000+0	6.3860+3		
LEVEL DENSITY PARAMETER	1.657E 01(1/MEV)	300.00000+0	13.3529+0	5.6329+0		7.7200+0	6.5357+3		
PAIRING ENERGY .....	1.701E 01(1/MEV) COM.	1.0000+3	9.9106+0	5.6206+0		4.2900+0	7.4230+3		
NORMALIZATION FACTOR .....	1.592E 03(1/MEV) TAG.	3.0000+3	8.3626+0	5.5926+0		2.7700+0	10.4594+3		
TANGENCY POINT .....	5.252E 00(MEV) TAG.	10.0000+9	7.7934+0	5.7154+0		2.0800+0	22.0005+3		
6.489E 00(MEV) COM.									
ADOPTED LEVELS (MEV)									
1. GROUND	5/2+	216.0170+3	8.6691+0	7.9935+0	233.750+3	483.978+3	261.2800+3		
2. 0.1157	1/2+	300.00000+3	8.5331+0	7.7663+0	349.789+3	397.0000+3	318.4180+3		
3. 0.214	11/2-	305.6540+3	8.5204+0	7.7070+0	403.8170+3	382.3021+3	323.9633+3		
4. 0.3028	5/2+	315.1430+3	8.4590+0	7.8113+0	7.9028+0	798.0000+3	146.7510+3		
5. 0.3122	7/2+	351.4220+3	8.4171+0	7.9522+0	0.0	720.9249+3	165.8120+3		
6. 0.3482	3/2+	369.4500+3	8.3766+0	7.8015+0	1.0345+0	260.6565+3	386.2866+3		
7. 0.366	9/2+	385.5000+3	8.3065+0	6.9020+0	1.1993+0	239.1954+3	401.9712+3		
8. 0.3819	3/2+	396.0590+3	8.3166+0	6.7807+0	1.3699+0	226.4398+3	412.3288+3		
9. 0.3924	7/2+	400.00000+3	8.3078+0	6.7356+0	1.3202+0	222.0000+3	416.1410+3		
10. 0.4112	1/2+	415.8840+3	8.2697+0	6.6339+0	1.4297+0	206.0964+3	427.6215+3		
11. 0.4712	3/2+								
475.6420+3	8.1265+0	6.2363+0	1.7334+0	159.5035+3	470.8128+3				
500.00000+3	8.0681+0	6.0637+0	1.8593+0	145.0000+3	488.4180+3				
573.0520+3	7.9831+0	5.8666+0	1.9134+0	113.0869+3	512.8663+3				
600.00000+3	7.8285+0	5.7910+0	1.9335+0	104.0000+3	521.8850+3				
700.00000+3	7.5945+0	5.6013+0	1.9033+0	89.8000+3	539.9290+3				
800.00000+3	7.3678+0	5.4274+0	1.8618+0	78.5000+3	551.0730+3				
900.00000+3	7.1492+0	5.2554+0	1.8214+0	72.5000+3	558.2990+3				
1.0000+6	6.9393+0	5.0818+0	1.7883+0	69.2000+3	563.2020+3				
1.2500+6	6.4487+0	4.6625+0	1.7430+0	63.2000+3	570.4370+3				
1.5000+6	6.0034+0	4.2113+0	1.7330+0	59.0000+3	574.6100+3				
1.7500+6	5.5984+0	3.8066+0	1.7367+0	55.1000+3	577.5550+3				
2.0000+6	5.2323+0	3.4390+0	1.7434+0	50.7000+3	579.7250+3				
2.5000+6	4.6287+0	2.8324+0	1.7559+0	40.4000+3	581.0620+3				
3.0000+6	4.2054+0	2.3951+0	1.7788+0	31.7000+3	577.7010+3				
4.0000+6	3.8570+0	1.9574+0	1.8821+0	17.5000+3	570.3370+3				
6.0000+6	4.0463+0	2.1026+0	1.9397+0	3.9100+3	663.1460+3				
8.0000+6	4.3260+0	2.4985+0	1.8267+0	780.0000+6	766.8590+3				
10.0000+6	4.3587+0	2.7314+0	1.8273+0	210.0000+6	826.3800+3				
11.0000+6	4.3316+0	2.7772+0	1.8642+0	130.0000+6	845.3630+3				
12.0000+6	4.6773+0	2.7822+0	1.8690+0	80.0000+6	859.3250+3				
15.0000+6	4.4335+0	2.5889+0	1.8447+0	10.0000+6	879.1110+3				
CROSS SECTION FOR EXCITATION OF LEVELS									
ENERGY(EV)	1-ST	2-ND	3-TH	4-TH	5-TH	6-TH	7-TH	8-TH	9-TH
116.7910+3	0.0 +0								
200.00000+3	235.8120+3								
216.0170+3	248.8910+3	0.0 +0							
300.00000+3	317.4690+3	32.3308+3							
305.6540+3	314.0629+3	32.8272+3	0.0 +0						
315.1430+3	308.3466+3	33.6603+3	43.7542+3	0.0 +0					
351.4820+3	326.4552+3	36.8508+3	211.3151+3	169.8165+3	0.0 +0				
369.4500+3	275.6309+3	38.4284+3	294.1665+3	253.7832+3	42.2836+3	0.0 +0			
385.5000+3	265.9671+3	39.8373+3	366.1739+3	328.7868+3	80.0536+3	35.5559+3	0.0 +0		
396.0590+3	259.5770+3	40.7611+3	417.0463+3	378.3172+3	104.9939+3	59.0360+3	19.7720+3	0.0 +0	
400.00000+3	257.2270+3	41.1106+3	435.0304+3	396.4707+3	114.1760+3	67.6780+3	27.0491+3	11.4174+3	
415.8840+3	241.8873+3	42.3590+3	433.3573+3	397.7802+3	127.4623+3	85.2449+3	46.9098+3	45.7967+3	0.0 +0
475.6420+3	164.1530+3	47.0555+3	427.0492+3	402.4108+3	171.4475+3	151.3363+3	121.6288+3	175.1366+3	28.0103+3
500.00000+3	160.6270+3	48.9699+3	424.4780+3	404.3110+3	197.8220+3	178.2730+3	152.0850+3	227.8570+3	39.4276+3
573.0520+3	129.5053+3	57.1165+3	387.2909+3	377.3124+3	196.5275+3	193.4956+3	168.1287+3	267.6711+3	51.6900+3
600.00000+3	118.0270+3	60.1217+3	373.5730+3	367.3530+3	196.0500+3	199.1110+3	174.0470+3	282.3800+3	56.2135+3
700.00000+3	98.6765+3	66.4073+3	330.8690+3	333.3140+3	143.5190+3	202.2720+3	171.1380+3	285.7930+3	59.7799+3
800.00000+3	87.4890+3	67.5507+3	296.6450+3	305.0810+3	170.4880+3	200.8710+3	162.6010+3	275.2920+3	59.6335+3
900.00000+3	80.2287+3	68.6975+3	269.6720+3	262.6750+3	158.6110+3	197.9300+3	153.3690+3	261.7670+3	58.3448+3
1.00000+6	75.3192+3	65.5738+3	248.3110+3	263.8800+3	149.6600+3	194.9590+3	144.5590+3	248.5590+3	56.8760+3
1.25000+6	68.3705+3	63.7208+3	210.6270+3	230.4120+3	131.5620+3	165.8140+3	128.7840+3	220.6240+3	54.0348+3
1.50000+6	64.1248+3	62.4204+3	165.0010+3	205.7800+3	119.7250+3	174.3500+3	117.3790+3	199.0580+3	52.1559+3
1.75000+6	59.9207+3	60.4451+3	164.7120+3	184.3520+3	109.9180+3	161.3780+3	107.9800+3	178.0740+3	50.2599+3
2.00000+6	54.8237+3	57.0986+3	145.9440+3	163.1360+3	99.9952+3	145.3430+3	98.4490+3	198.2490+3	47.5044+3
2.50000+6	42.6081+3	47.6659+3	109.0720+3	120.2120+3	77.9131+3	108.1590+3	77.1556+3	117.8150+3	39.0454+3
3.00000+6	29.6313+3	36.5224+3	73.5185+3	79.4548+3	54.2204+3	71.1381+3	53.8991+3	78.4453+3	28.1248+3
4.00000+6	9.8864+3	16.4446+3	23.4493+3	24.6733+3	17.9483+3	21.9225+3	17.8982+3	24.5035+3	9.6447+3
6.00000+6	475.3219+6	1.3804+3	1.1416+3	1.2280+3	868.5161+6	1.1498+3	866.9081+6	1.2216+3	467.9980+6
8.00000+6									
10.00000+6									
11.00000+6									
12.00000+6									
13.00000+6									

TABLE A2 - 13

NUCLEUS ... 47-AG-109

PARAMETERS	CROSS SECTION(BAHN) AND MU-BAR					
	ENERGY(EV)	TOTAL	ELASTIC	INELASTIC	CAPTURE	MU-BAR
NEUTRON SEPARATION ENERGY 6.828E 00(MEV)	100.0000+0	19.7443+0	6.5643+0	13.2000+0	6.2331+3	
LEVEL PARAMETER(XI=ZERO) 6.230E 01	300.0000+0	13.6383+0	6.1383+0	7.5000+0	6.4366+3	
LEVEL SPACING 1.27DE 01(MEV)	1.0000+3	9.9933+0	5.9933+0	4.0000+0	7.4021+3	
LEVEL DENSITY PARAMETER 1.680E 01(1/MEV)	3.0000+3	8.3283+0	5.8783+0	2.4500+3	10.7328+3	
TANGENCY POINT 1.717E 01(1/MEV) COM.	10.0000+3	7.6635+0	5.8534+0	1.8100+0	23.3810+3	
PAIRING ENERGY 1.292E 00(MEV) TAG.	20.0000+3	7.6834+0	6.1634+0	1.5200+0	41.2448+3	
NORMALIZATION FACTOR 1.444E 03(1/MEV) TAG.	50.0000+3	8.0093+0	6.9793+0	1.0200+0	90.1660+3	
TANGENCY POINT 3.126E 00(MEV) TAG.	88.8466+3	8.2357+0	7.4880+0	0.0 +0	747.6809+3	142.6882+3
COM. 3.664E 00(MEV) COM.	100.0000+3	8.3008+0	7.5908+0	9.9411+3	700.0000+3	157.7680+3
	134.0290+3	8.3301+0	7.7300+0	19.2943+3	586.7881+3	190.6002+3
ADOPTED LEVELS (MEV)						
1. GHOUND 1/2-	200.0000+3	8.3871+0	7.8982+0	38.8829+3	420.0000+3	294.2510+3
2. 0.08803 7/2+	300.0000+3	8.2671+0	7.8225+0	44.5820+3	360.0000+3	316.9880+3
3. 0.1328 9/2+	317.3090+3	8.2368+0	7.7039+0	178.2280+3	325.9965+3	
4. 0.3144 3/2-	400.0000+3	8.0921+0	7.0866+0	757.5560+3	220.0000+3	301.9690+3
5. 0.4153 5/2+	419.1430+3	8.0556+0	6.9819+0	840.2810+3	233.3736+3	403.0813+3
6. 0.7019 3/2-	500.0000+3	7.9013+0	6.1524+0	1.1966+0	180.0000+3	450.0180+3
7. 0.7244 3/2+	600.0000+3	7.7077+0	6.2129+0	1.3367+0	152.0000+3	482.8310+3
8. 0.7353 5/2+	700.0000+3	7.5107+0	5.9955+0	1.3732+0	142.0000+3	501.9100+3
9. 0.8398 7/2-	708.3950+3	7.4494+0	5.9713+0	1.3830+0	140.1906+3	503.7423+3
10. 0.8627 5/2-	731.1020+3	7.4506+0	5.9055+0	1.4036+0	135.1211+3	508.6985+3
11. 0.8695 3/2+	742.1040+3	7.4293+0	5.8735+0	1.4225+0	133.3524+3	511.0996+3
12. 0.9110 7/2-	800.0000+3	7.3174+0	5.7037+0	1.4907+0	123.0000+3	523.7360+3
13. 0.9123 3/2+	847.5710+3	7.2270+0	5.5884+0	1.5232+0	115.4000+3	530.8293+3
	870.6830+3	7.1851+0	5.5320+0	1.5391+0	112.0223+3	534.2756+3
	877.5460+3	7.1701+0	5.5152+0	1.5438+0	111.0553+3	535.2989+3
	900.0000+3	7.1274+0	5.4601+0	1.5552+0	108.0000+3	538.6470+3
	919.3950+3	7.0912+0	5.4165+0	1.5700+0	104.7752+3	540.8927+3
	920.7420+3	7.0888+0	5.4135+0	1.5707+0	104.5634+3	541.0444+3
	1.0000+6	6.9412+0	5.2335+0	1.6147+0	93.0000+3	550.2020+3
	1.2500+6	6.4921+0	4.7546+0	1.6595+0	78.0000+3	564.9640+3
	1.5000+6	6.0683+0	4.3143+0	1.6790+0	75.0000+3	573.3250+3
	1.5240+6	6.0303+0	4.2739+0	1.6818+0	74.5784+3	574.1038+3
	1.7500+6	5.6719+0	3.8927+0	1.7081+0	71.0000+3	581.4480+3
	2.0000+6	5.3079+0	3.4977+0	1.7453+0	65.0000+3	590.3460+3
	2.5000+6	4.6983+0	2.8557+0	1.7916+0	51.0000+3	600.7340+3
	3.0000+6	4.2694+0	2.4059+0	1.8235+0	40.0000+3	598.7060+3
	4.0000+6	3.9116+0	1.9630+0	1.9266+0	22.0000+3	581.6900+3
	6.0000+6	4.0494+0	2.0846+0	1.9555+0	4.7000+3	661.3240+3
	8.0000+6	4.3213+0	2.4762+0	1.8442+0	910.0000+6	762.5750+3
	10.0000+6	4.5922+0	2.7301+0	1.8618+0	260.0000+6	823.9780+3
	11.0000+6	4.6875+0	2.7889+0	1.8984+0	200.0000+6	844.2530+3
	12.0000+6	4.7226+0	2.8041+0	1.9183+0	100.0000+6	859.1040+3
	15.0000+6	4.4678+0	2.6232+0	1.8446+0	10.0000+6	880.2370+3

## CROSS SECTION FOR EXCITATION OF LEVELS

ENERGY(EV)	1-ST	2-ND	3-TH	4-TH	5-TH	6-TH	7-TH	8-TH	9-TH
88.6465+3	0.0 +0								
100.0000+3	9.9411+3								
134.0280+3	18.4717+3	0.0 +0							
200.0000+3	35.0097+3	3.8712+3							
300.0000+3	72.0651+3	12.5168+3							
317.3090+3	76.5031+3	14.0768+3	0.0 +0						
400.0000+3	97.7048+3	21.2984+3	638.5320+3						
419.1430+3	100.5485+3	22.4042+3	674.7044+3	0.0 +0					
500.0000+3	112.5600+3	27.0749+3	877.4910+3	229.5260+3					
600.0000+3	132.6560+3	33.8022+3	804.3370+3	363.3657+3					
700.0000+3	154.5500+3	42.1158+3	765.3330+3	411.1810+3					
708.3950+3	155.8115+3	42.0568+3	754.0568+3	404.8409+3	0.0 +0				
731.1030+3	151.8679+3	43.3154+3	723.5555+3	402.5110+3	39.2723+3	0.0 +0			
742.1040+3	150.9263+3	43.7397+3	708.7789+3	399.4445+3	58.2979+3	13.6682+3	0.0 +0		
800.0000+3	145.9710+3	45.9726+3	631.0130+3	383.3060+3	158.4260+3	85.6009+3	40.4151+3		
847.5710+3	138.8715+3	45.9882+3	581.3903+3	364.3642+3	203.4020+3	157.1107+3	57.5728+3	0.0 +0	
870.6830+3	135.4223+3	45.9957+3	557.2666+3	385.0734+3	225.2432+3	117.5560+3	65.9088+3	8.8455+3	0.0 +0
877.5460+3	134.3980+3	45.9980+3	550.1062+3	352.3310+3	231.7419+3	120.6587+3	68.3841+3	11.4722+3	4.8643+3
900.0000+3	131.0470+3	46.0053+3	528.6790+3	343.3670+3	252.9710+3	130.8100+3	76.4273+3	20.0569+3	20.7791+3
919.4300+3	127.6516+3	45.1485+3	508.4508+3	332.4406+3	256.4742+3	130.4194+3	77.7440+3	25.9558+3	34.7340+3
920.7420+3	127.4223+3	45.2365+3	507.2199+3	331.7031+3	256.7148+3	130.3887+3	77.8291+3	26.3535+3	35.6763+3
1.0000+6	119.5720+3	42.2990+3	432.8640+3	287.1530+3	271.0510+3	128.7790+3	82.9740+3	50.3792+3	92.6003+3
1.2500+6	109.8090+3	46.9937+3	326.4560+3	234.0530+3	251.7940+3	122.3050+3	93.0699+3	79.1382+3	153.4130+3
1.5000+6	120.5040+3	58.4049+3	277.6860+3	218.8640+3	232.7640+3	124.1650+3	105.4510+3	93.4084+3	165.9040+3
1.5240+6	120.3699+3	58.8408+3	273.0327+3	216.5743+3	229.2589+3	123.4433+3	105.5739+3	93.5189+3	162.8020+3
1.7500+6	119.1050+3	62.9058+3	229.0590+3	194.9830+3	196.2070+3	116.7720+3	106.7330+3	94.5607+3	152.3730+3
2.0000+6	98.9580+3	55.2637+3	169.5450+3	152.3000+3	147.7760+3	95.5980+3	91.4981+3	80.5394+3	122.4750+3
2.5000+6	58.7867+3	36.3765+3	83.6080+3	80.7511+3	75.4131+3	55.8598+3	56.7643+3	49.3697+3	68.7251+3
3.0000+6	32.6021+3	22.2672+3	39.1703+3	39.8141+3	36.2046+3	29.7884+3	31.6356+3	27.1419+3	35.3063+3
4.0000+6	9.1519+3	7.2442+3	8.5165+3	9.4012+3	7.9426+3	7.3588+3	8.4455+3	7.4167+3	8.5236+3
6.0000+6	520.2410+6	460.1380+6	444.9231+6	538.1890+6	424.5050+6	375.2710+6	467.6450+6	512.7140+6	506.1079+6
8.0000+6									
10.0000+6									
11.0000+6									
12.0000+6									
15.0000+6									

TABLE A2 - 14

NUCLEUS ... 53-1 -129

PARAMETERS	CROSS SECTION(CHARN) AND MU-BAR								
	ENERGY(EV)	TOTAL	ELASTIC	INELASTIC	CAPTURE	MU-BAR			
NEUTRON SEPARATION ENERGY 6.461E 00(MEV)	100.0000+0	47.7344+0	17.0344+0		30.7000+0	5.2400+3			
LEVEL SPACING ..... 2.100E 01(MEV)	300.0000+0	29.1509+0	14.6509+0		14.5000+0	5.3463+3			
LEVEL DENSITY PARAMETER .. 1.587E 01(1/MEV) TAG,	1.0000+3	17.7045+0	11.7545+0		5.9500+0	5.9468+3			
1.499E 01(1/MEV) COM,	3.0000+3	11.9040+0	9.2400+0		2.6100+0	8.4737+3			
PAIRING ENERGY ..... 1.200E 00(MEV) TAG,	10.0000+3	8.4263+0	7.2083+0		1.2200+0	20.2810+3			
0.100E 00(MEV) COM	0.0000+0								
NORMALIZATION FACTOR .... 1.839E 03(1/MEV) TAG,	20.0000+3	7.2653+0	6.4213+0		844.0000+3	39.1800+3			
TANGENCY POINT ..... 4.463E 00(MEV) TAG,	27.9871+3	7.0174+0	6.3594+0	0.0 +0	663.0020+3	55.9007+3			
3.654E 00(MEV) COM,	50.0000+3	6.3341+0	5.4871+0	469.9110+3	437.0000+3	101.9840+3			
100.0000+3	5.9586+0	5.1767+0	516.8750+3	265.0000+3	188.7960+3				
200.0000+3	5.8434+0	5.0967+0	561.6800+3	185.0000+3	301.8830+3				
ADOPTED LEVELS (MEV)									
1. GROUND 7/2+	280.5970+3	5.9096+0	5.1511+0	593.7860+3	164.7317+3	352.7722+3			
2. 0.07777 5/2+	300.0000+3	5.9255+0	5.1630+0	601.5630+3	161.0000+3	364.4030+3			
3. 0.77842 5/2+	400.0000+3	6.0598+0	5.2352+0	676.6540+3	148.0000+3	401.5490+3			
4. 0.48738 3/2*	491.1910+3	6.1899+0	5.3249+0	722.5760+3	142.4689+3	419.9568+3			
5. 0.55347 1/2+	500.0000+3	6.2025+0	5.3335+0	727.0200+3	142.0000+3	421.7350+3			
6. 0.69598 11/2+	563.9450+3	6.2872+0	5.3885+0	758.1100+3	140.6766+3	429.6028+3			
7. 0.72467 9/2+	600.0000+3	6.3350+0	5.4144+0	775.6550+3	140.0000+3	434.0390+3			
8. 0.76689 7/2-	700.0000+3	6.4491+0	5.4849+0	818.5080+3	141.0000+3	442.3840+3			
9. 0.8299 3/2+	701.4220+3	6.4504+0	5.4873+0	822.5800+3	140.2866+3	442.7144+3			
10. 0.8450 7/2-	735.3250+3	6.4814+0	5.4364+0	920.3620+3	124.6798+3	452.0072+3			
11. 1.0204 9/2+	774.9120+3	6.5176+0	5.3720+0	1.0363+0	109.3694+3	462.7915+3			
12. 1.052 5/2+	800.0000+3	6.5406+0	5.3289+0	1.1107+0	101.0000+3	469.6260+3			
13. 1.11175 3/2+	836.3890+3	6.5652+0	5.2973+0	1.1723+0	95.5487+3	476.3594+3			
	851.6070+3	6.5754+0	5.2839+0	1.1981+0	93.4237+3	479.1754+3			
	900.0000+3	6.6081+0	5.2402+0	1.2807+0	87.2000+3	488.1300+3			
	1.0000+6	6.6518+0	5.1849+0	1.3853+0	81.6000+3	502.1930+3			
1.0586+6	6.6549+0	5.1439+0	1.4342+0	76.8156+3	510.5614+3				
1.1062+6	6.6550+0	5.1428+0	1.4355+0	76.6911+3	510.8132+3				
1.1204+6	6.6581+0	5.0994+0	1.4859+0	72.3765+3	519.4285+3				
1.1288+6	6.6586+0	5.0939+0	1.4929+0	71.7611+3	520.6190+3				
1.2500+6	6.6649+0	5.0054+0	1.5051+0	64.4000+3	537.9670+3				
1.3500+6	6.5659+0	4.7532+0	1.7706+0	42.1000+3	516.2280+3				
1.7500+6	6.3926+0	4.4779+0	1.8873+0	30.0000+3	610.4010+3				
2.0000+6	6.1797+0	4.1947+0	1.9810+0	24.2000+3	638.4050+3				
2.5000+6	5.7310+0	3.6428+0	2.0726+0	15.5000+3	674.3250+3				
3.0000+6	5.3207+0	3.1561+0	2.1537+0	11.0000+3	666.9790+3				
4.0000+6	4.6708+0	2.4713+0	2.1942+0	5.2600+3	671.9310+3				
6.0000+6	4.1556+0	2.0734+0	2.0813+0	290.0000+6	653.9220+3				
8.0000+6	4.3965+0	2.3158+0	2.0825+0	210.0000+6	724.3750+3				
10.0000+6	4.6916+0	2.6631+0	2.0344+0	90.0000+6	803.6320+3				
11.0000+6	4.7763+0	2.7861+0	1.9901+0	30.0000+6	831.7340+3				
12.0000+6	4.8190+0	2.8626+0	1.9564+0	20.0000+6	852.5350+3				
15.0000+6	4.8422+0	2.8604+0	1.9818+0	885.6710+3					
CROSS SECTION FOR EXCITATION OF LEVELS									
ENERGY(EV)	1-ST	2-ND	3-TH	4-TH	5-TH	6-TH	7-TH	8-TH	9-TH
27.9871+3	0.0 +0								
50.0000+3	409.9110+3								
100.0000+3	516.8750+3								
200.0000+3	561.6800+3								
280.5970+3	550.0628+3	0.0 +0							
300.0000+3	547.2660+3	54.2981+3							
400.0000+3	504.6550+3	172.0000+3							
491.1910+3	490.8906+3	224.4895+3	0.0 +0						
500.0000+3	489.5610+3	229.5600+3	7.8991+3						
563.9450+3	481.4477+3	247.9487+3	25.4247+3	0.0 +0					
600.0000+3	476.8730+3	298.3170+3	35.3064+3	5.1589+3					
700.0000+3	474.7150+3	279.6040+3	53.4980+3	10.6913+3					
701.4220+3	474.0898+3	279.5535+3	53.7002+3	10.7577+3	0.0 +0				
735.3250+3	459.1847+3	278.3503+3	58.5211+3	12.3420+3	57.2064+3	0.0 +0			
774.9120+3	441.7807+3	276.9454+3	64.1502+3	14.1918+3	124.0037+3	68.9704+3	0.0 +0		
800.0000+3	430.7510+3	276.0550+3	67.7176+3	15.3641+3	166.3380+3	112.6800+3	41.7849+3		
836.3890+3	413.2519+3	269.2939+3	70.0533+3	16.5374+3	130.9467+3	133.4639+3	66.0178+3	0.0 +0	
851.6070+3	405.9337+3	266.4664+3	71.0302+3	17.0281+3	187.0485+3	142.1559+3	76.1521+3	3.2568+3	0.0 +0
900.0000+3	382.6670+3	257.4750+3	74.1364+3	18.5885+3	206.4710+3	164.9760+3	108.3750+3	13.6134+3	49.6151+3
1.0000+6	351.0300+3	246.2620+3	79.6071+3	21.7665+3	227.8330+3	194.2150+3	139.9870+3	25.6405+3	98.8885+3
1.0586+6	335.2806+3	239.2454+3	80.8539+3	23.0729+3	227.9424+3	196.4975+3	143.9190+3	29.2216+3	107.3404+3
1.0602+6	334.8452+3	239.0515+3	80.8884+3	23.1080+3	227.9465+3	196.5606+3	144.0277+3	29.3263+3	107.5740+3
1.1204+6	318.6658+3	231.8434+3	82.1693+3	24.4551+3	228.0599+3	198.9054+3	144.0671+3	32.9995+3	116.2567+3
1.1288+6	316.4301+3	230.8474+3	82.3465+3	24.6388+3	228.0756+3	199.2294+3	144.6253+3	33.5078+3	117.8565+3
1.2500+6	283.8510+3	216.3330+3	84.9255+3	27.3453+3	228.3040+3	203.9510+3	156.7590+3	40.9157+3	134.9400+3
1.5000+6	224.3840+3	182.4420+3	82.2430+3	29.6134+3	185.9820+3	184.2780+3	146.5710+3	47.9519+3	131.8040+3
1.7500+6	173.0760+3	147.3170+3	73.4743+3	28.6462+3	186.6260+3	155.9130+3	130.5520+3	49.2376+3	120.0470+3
2.0000+6	132.2460+3	115.9720+3	62.2345+3	25.7174+3	117.5410+3	126.5560+3	112.9830+3	46.0282+3	105.7020+3
2.5000+6	76.4849+3	69.2760+3	40.8688+3	14.2737+3	70.2118+3	77.1094+3	77.8087+3	33.7042+3	74.5398+3
3.0000+6	43.2267+3	39.8892+3	24.9450+3	11.7315+3	40.3525+3	44.2330+3	48.7050+3	21.5639+3	47.1788+3
4.0000+6	12.1281+3	11.5046+3	7.6905+3	3.8285+3	12.0207+3	12.9394+3	15.7400+3	7.0021+3	15.4045+3
6.0000+6	743.9731+6	716.0630+6	493.6500+6	253.0550+6	820.7399+6	844.7680+6	1.1343+3	466.6500+6	1.1243+3
8.0000+6									
10.0000+6									
11.0000+6									
12.0000+6									
15.0000+6									

TABLE A2 - 15

NUCLEUS ... 54-XF-131

## PARAMETERS

## CROSS SECTION (RAHN) AND NUC-BAR

	ENERGY(EV)	TOTAL	ELASTIC	INELASTIC	CAPTURE	MU-BAR
NEUTRON SEPARATION ENERGY	8.932E 00(MEV)					
LEVEL PARAMETER(XI-ZERO)	3.704E 02					
LEVEL SPACING .....	3.200E 01(MEV)					
LEVEL DENSITY PARAMETER	1.614E 01(1/MEV)					
PAIRING ENERGY .....	1.497E 01(1/MEV) TAG.					
NORMALIZATION FACTOR .....	1.899E 03(1/MEV) TAG.					
TANGENCY POINT .....	4.765E 00(MEV) TAG.					
ADOPTED LEVELS (MEV)						
1. GROUND	3/2+	200.0000+3	5.7116+0	5.1395+0	399.1140+3	183.0000+3
2. 0.0816	1/2+	300.0000+3	5.7860+0	5.1687+0	467.7740+3	150.0000+3
3. 0.16398	11/2-	328.2880+3	5.8262+0	5.1122+0	582.6200+3	132.5223+3
4. 0.32578	3/2+	367.2760+3	5.8830+0	5.0769+0	742.6000+3	113.5750+3
5. 0.36447	5/2+	400.0000+3	5.9303+0	5.0497+0	879.5560+3	101.0000+3
6. 0.50303	5/2-	500.0000+3	6.0470+0	5.0955+0	79.1000+3	443.4740+3
7. 0.63770	5/2+	506.8730+3	6.1019+0	5.1057+0	77.1552+3	444.6966+3
8. 0.7229	7/2+	600.0000+3	6.2453+0	5.1918+0	1.2624+0	64.0000+3
		641.9050+3	6.3078+0	5.1939+0	1.3030+0	60.5530+3
		700.0000+3	6.3826+0	5.1950+0	1.3721+0	56.4000+3
		728.4660+3	6.4152+0	5.1959+0	1.4016+0	53.8493+3
		735.6210+3	6.4235+0	5.1961+0	1.4090+0	53.2416+3
		800.0000+3	6.4974+0	5.1973+0	1.4758+0	48.3000+3
		900.0000+3	6.5973+0	5.1980+0	1.5562+0	44.1000+3
		1.0000+6	6.6516+0	5.1990+0	1.6311+0	41.4000+3
		1.2500+6	6.7076+0	4.8892+0	1.7837+0	34.7000+3
		1.5000+6	6.6396+0	4.7163+0	1.8930+0	30.3000+3
		1.7500+6	6.6987+0	4.4915+0	1.9697+0	26.7000+3
		2.0000+6	6.7486+0	4.2383+0	2.0767+0	23.7000+3
		2.5000+6	6.8518+0	3.7134+0	2.1201+0	18.2000+3
		3.0000+6	5.9322+0	3.2320+0	2.1851+0	14.2000+3
		4.0000+6	4.7441+0	2.5340+0	2.2028+0	7.2200+3
		6.0000+6	4.1824+0	2.0867+0	2.0953+0	1.4400+3
		8.0000+6	4.4036+0	2.3084+0	2.0969+0	33.0000+6
		10.0000+6	4.6882+0	2.6516+0	2.0364+0	90.0000+6
		11.0000+6	4.7712+0	2.7779+0	1.9932+0	50.0000+6
		12.0000+6	4.8241+0	2.8598+0	1.9663+0	30.0000+6
		15.0000+6	4.8871+0	2.8797+0	2.0075+0	885.8780+3

## CROSS SECTION FOR EXCITATION OF LEVELS

ENERGY(EV)	1-ST	2-ND	3-TH	4-TH	5-TH	6-TH	7-TH
80.7772+3	0.0 +0						
100.0000+3	201.2330+3						
165.2430+3	312.1383+3	0.0 +0					
200.0000+3	371.2210+3	18.8974+3					
300.0000+3	415.1310+3	52.1424+3					
328.2880+3	400.6920+3	60.5363+3	6.00 +0				
367.2760+3	380.7913+3	72.2176+3	138.8909+3	0.0 +0			
400.0000+3	364.0880+3	81.9825+3	255.4670+3	178.0210+3			
500.0000+3	326.6690+3	100.3140+3	378.1390+3	333.3660+3			
506.8730+3	324.7018+3	100.4310+3	338.2220+3	334.0405+3	0.0 +0		
600.0000+3	298.0470+3	102.0170+3	339.3460+3	363.1790+3	179.8490+3		
641.9050+3	289.3195+3	103.3056+3	336.8577+3	334.2588+3	203.4759+3	0.0 +0	
700.0000+3	277.2200+3	105.0920+3	331.4080+3	333.8240+3	236.2310+3	K6.3412+3	
728.4660+3	272.5351+3	101.1584+3	330.3670+3	326.1314+3	239.1431+3	101.2175+3	0.0 +0
735.6210+3	271.3575+3	100.1702+3	324.6026+3	327.9519+3	239.8750+3	104.9567+3	7.9119+3
800.0000+3	260.7620+3	91.2750+3	322.7250+3	317.3990+3	246.4610+3	138.6010+3	79.1015+3
900.0000+3	246.5240+3	45.2810+3	312.9330+3	307.4100+3	247.8950+3	163.0700+3	110.4070+3
1.0000+6	232.4330+3	80.8559+3	309.8630+3	300.2630+3	244.1320+3	175.8740+3	124.2440+3
1.2500+6	195.7210+3	72.4224+3	271.5240+3	275.4140+3	224.4790+3	186.0480+3	135.8940+3
1.5000+6	158.4250+3	64.8493+3	230.8400+3	239.1320+3	198.3870+3	178.1070+3	134.2800+3
1.7500+6	124.0200+3	57.1410+3	187.3480+3	197.3200+3	169.0300+3	158.2070+3	123.4630+3
2.0000+6	94.4818+3	49.3464+3	146.3880+3	156.0460+3	138.6580+3	132.2340+3	106.5810+3
2.5000+6	31.5471+3	34.8417+3	87.5292+3	90.7121+3	84.6744+3	81.3699+3	69.3417+3
3.0000+6	26.4882+3	22.6110+3	43.4765+3	49.1042+3	47.0995+3	45.2416+3	40.4313+3
4.0000+6	6.2874+3	7.5976+3	10.6945+3	12.7277+3	12.5304+3	12.0352+3	11.5539+3
6.0000+6	249.5110+6	636.0951+6	532.5461+6	670.4570+6	138.1381+6	649.9530+6	676.1400+6
8.0000+6	18.0816+6	52.8517+6	32.9126+6	42.8650+6	48.913+6	41.4756+6	45.8175+6
10.0000+6							
11.0000+6							
12.0000+6							
15.0000+6							

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NUCLEUS ... 55-CS-133

PARAMETERS	CROSS SECTION(BARN) AND MU-BAR					
	ENERGY(EV)	TOTAL	ELASTIC	INELASTIC	CAPTURE	MU-BAR
NEUTRON SEPARATION ENERGY 6.701E 00(MEV)	100.0000+0	62.1923+0	24.3923+0	37.8000+0	5.0757+3	
LEVEL PARAMETER(XI-ZERO) . 5.040E 02	300.0000+0	37.3465+0	20.1465+0	17.2000+0	5.1548+3	
LEVEL SPACING ..... 2.490E 01(MEV)	1.0000+3	22.0242+0	15.2242+0	6.8000+0	5.6129+3	
LEVEL DENSITY PARAMETER .. 1.613E 01(1/MEV) TAG,	3.0000+3	14.2214+0	11.3714+0	2.8500+0	7.6214+3	
1.445E 01(1/MEV) COM,	10.0000+3	9.4697+0	8.2297+0	1.7400+0	17.5610+3	
PAIRING ENERGY ..... 1.040E 00(MEV) TAG,	0.0					
NORMALIZATION FACTOR .... 1.927E 03(1/MEV) TAG,	20.0000+3	7.8232+0	6.9926+0	840.0000+3	34.2557+3	
TANGENCY POINT ..... 4.668E 00(MEV) TAG,	50.0000+3	5.9446+0	5.0446+0	504.0000+3	85.5397+3	
3.619E 00(MEV) COM,	81.6143+3	6.0648+0	5.7040+0	0.0 +0	359.9617+3	137.0857+3
100.0000+3	5.8404+0	5.2695+0	257.8330+3	313.0000+3	167.0630+3	
161.7170+3	5.6840+0	5.0257+0	428.8340+3	229.4321+3	240.6562+3	
ADOPTED LEVELS (MEV)						
1. GROUND 7/2+	200.0000+3	5.5870+0	4.8486+0	538.3860+3	200.0000+3	286.3060+3
2. 0.0810 5/2+	300.0000+3	5.6663+0	4.8287+0	649.5840+3	168.0000+3	352.3710+3
3. 0.1605 5/2+	385.7030+3	5.7767+0	4.9149+0	707.0130+3	154.8212+3	382.1348+3
4. 0.3828 3/2+	400.0000+3	5.7985+0	4.9288+0	716.6449+3	153.0000+3	387.1000+3
5. 0.4371 1/2+	446.4150+3	5.8709+0	4.9853+0	761.1180+3	144.4945+3	396.3542+3
443.3370+3	5.8762+0	4.9679+0	764.9279+3	143.9279+3	397.0233+3	
500.0000+3	5.9778+0	5.0164+0	827.2800+3	134.0000+3	409.9980+3	
600.0000+3	6.1564+0	5.0545+0	997.9330+3	104.0000+3	430.3270+3	
700.0000+3	6.3199+0	5.0857+0	1.1494+0	84.8000+3	446.7090+3	
800.0000+3	6.4610+0	5.1114+0	1.2855+0	66.2000+3	461.4820+3	
900.0000+3	6.5759+0	5.1211+0	1.4000+0	54.9000+3	476.1160+3	
1.0000+6	6.6632+0	5.1160+0	1.4993+0	47.9000+3	491.2120+3	
1.2500+6	6.7663+0	5.0425+0	1.6883+0	35.5000+3	530.7810+3	
1.5000+6	6.7313+0	4.8966+0	1.8067+0	28.0000+3	569.3040+3	
1.7500+6	6.6022+0	4.7015+0	1.8780+0	27.7000+3	602.4920+3	
2.0000+6	6.4186+0	4.4759+0	1.9239+0	18.9000+3	628.4030+3	
2.5000+6	5.9897+0	3.9893+0	1.9873+0	13.3000+3	658.4720+3	
3.0000+6	5.5577+0	3.5231+0	2.0248+0	9.8300+3	665.2120+3	
4.0000+6	4.8511+0	2.8120+0	2.0142+0	4.8300+3	639.2180+3	
6.0000+6	2.2210+0	2.3554+0	1.8646+0	970.0000+3	586.7750+3	
8.0000+6	4.4090+0	2.6317+0	1.7771+0	220.0000+6	628.1850+3	
10.0000+6	4.6777+0	2.6317+0	2.0466+0	60.0000+6	801.0570+3	
11.0000+6	4.7659+0	2.7584+0	2.0076+0	40.0000+6	829.9870+3	
12.0000+6	4.8302+0	2.8439+0	1.9863+0	70.0000+6	851.3970+3	
15.0000+6	4.9335+0	2.8833+0	2.0504+0	687.3040+3		

## CROSS SECTION FOR EXCITATION OF LEVELS

ENERGY(EV)	1-ST	2-ND	3-TH	4-TH
81.6143+3	0.0 +0			
100.0000+3	257.8330+3			
161.7170+3	338.5471+3	0.0 +0		
200.0000+3	388.6140+3	149.7740+3		
300.0000+3	392.6220+3	256.9610+3		
385.7030+3	400.8238+3	294.9926+3	0.0 +0	
400.0000+3	402.1920+3	301.3370+3	13.0611+3	
440.4150+3	402.9550+3	309.6770+3	23.7609+3	
443.3370+3	403.0102+3	310.2400+3	24.5345+3	388.2781+6
500.0000+3	404.0800+3	321.9730+3	39.5360+3	7.9177+3
600.0000+3	398.4450+3	330.2940+3	56.8733+3	13.1209+3
700.0000+3	387.8020+3	330.6070+3	73.4356+3	17.4871+3
800.0000+3	376.2330+3	327.7770+3	84.9710+3	21.7122+3
900.0000+3	361.6680+3	329.7840+3	91.5696+3	25.6073+3
1.0000+6	345.9710+3	311.5060+3	99.8344+3	29.0430+3
1.2500+6	303.9720+3	281.4530+3	106.6740+3	35.0846+3
1.5000+6	269.4170+3	247.5450+3	104.0080+3	36.9652+3
1.7500+6	226.3150+3	226.1050+3	96.6033+3	36.0453+3
2.0000+6	197.9300+3	190.1390+3	88.2075+3	33.9520+3
2.5000+6	159.9300+3	154.8110+3	74.8421+3	29.8563+3
3.0000+6	139.1990+3	135.2110+3	67.2787+3	27.5047+3
4.0000+6	126.1670+3	122.5780+3	64.3923+3	27.50R5+3
6.0000+6	158.0350+3	153.0000+3	87.7432+3	40.1633+3
8.0000+6	216.2230+3	211.6440+3	128.1050+3	59.9278+3
10.0000+6				
11.0000+6				
12.0000+6				
15.0000+6				

TABLE A2 - 17

NUCLEUS ... 55-CS-135

PARAMETERS		CROSS SECTION(BARN) AND MU-BAR					
		ENERGY(EV)	TOTAL	ELASTIC	INELASTIC	CAPTURE	MU-BAR
NEUTRON SEPARATION ENERGY	6.871E 00(MEV)						
LEVEL PARAMETER(XI=7FRC)	1.222E 03	100.0000*0	69.66779*0	43.06779*0	26.6000*0	4.9982*3	
LEVEL SPACING .....	6.000E 01(MEV)	300.0000*0	41.5845*0	30.98654*0	10.6000*0	5.0673*3	
LEVEL DENSITY PARAMETER	1.355E 01(1/MEV)	1.0000*3	24.2654*0	20.5254*0	3.7400*0	5.4715*3	
PAIRING ENERGY .....	1.235E 01(1/MEV) TAG.	3.0000*3	15.4363*0	13.9403*0	1.4900*0	7.2706*3	
PAIRING ENERGY .....	7.000E-02(1/MEV) TAG.	10.0000*3	9.3572*0		670.0000*3	16.3779*3	
PAIRING ENERGY .....	0.0 (1/MEV) COM.						
NORMALIZATION FACTOR .....	1.643E 03(1/MEV) TAG.	20.0000*3	8.1499*0	7.6999*0	450.0000*3	31.9859*3	
TANGENCY POINT .....	4.311E 00(1/MEV) TAG.	50.0000*3	6.5444*0	6.2934*0	251.0000*3	80.9709*3	
	3.603E 00(1/MEV) COM.	100.0000*3	5.8189*0	5.6529*0	166.0000*3	152.4110*3	
		200.0000*3	5.4945*0	5.3754*0	120.0000*3	248.4480*3	
		251.6660*3	5.5185*0	5.4135*0	0.0 +0	104.9312*3	281.7878*3
ADOPTED LEVELS (MEV)							
1. GROUND	7/2+	300.0000*3	5.5400*0	5.2219*0	223.4000*3	94.7000*3	312.9420*3
2. 0.2498	5/2+	400.0000*3	5.56972*0	5.2576*0	357.4690*3	82.1000*3	348.7150*3
3. 0.4082	3/2+	411.2500*3	5.7190*0	5.2687*0	369.1960*3	81.1687*3	351.0312*3
4. 0.6086	5/2+	500.0000*3	5.8911*0	5.3542*0	462.0350*3	74.9000*3	369.3030*3
5. 0.780	11/2+	600.0000*3	6.0891*0	5.4820*0	534.9330*3	72.1000*3	381.4570*3
6. 0.9817	1/2+	613.1470*3	6.1134*0	5.4910*0	500.5540*3	71.8298*3	383.2035*3
7. 1.0626	3/2+	700.0000*3	6.2738*0	5.5467*0	653.9160*3	70.2000*3	394.7410*3
		785.8280*3	6.4123*0	5.5390*0	810.7820*3	63.3916*3	410.2819*3
		800.0000*3	6.4362*0	5.5370*0	836.7950*3	62.4000*3	412.4480*3
		900.0000*3	6.5733*0	5.4828*0	1.0384*0	50.2000*3	433.9320*3
		989.0350*3	6.6655*0	5.4755*0	1.1493*0	46.6935*3	448.8605*3
		1.0000*6	6.6771*0	5.4745*0	1.1563*0	46.3000*3	450.6990*3
		1.0705*6	6.7166*0	5.4600*0	1.2113*0	45.2338*3	462.1649*3
		1.2500*6	6.8170*0	5.4223*0	1.3517*0	42.9000*3	491.3350*3
		1.5000*6	6.8074*0	5.2773*0	1.4868*0	43.3000*3	531.3580*3
		1.6331*6	6.7476*0	5.1721*0	1.5368*0	38.7468*3	549.5488*3
		1.7127*6	6.7118*0	5.1086*0	1.5667*0	36.4108*3	560.4236*3
		1.7500*6	6.6950*0	5.0789*0	1.5808*0	35.4000*3	565.5220*3
		2.0000*6	6.5231*0	4.6745*0	1.8376*0	18.6000*3	641.3190*3
		2.5000*6	6.0972*0	3.9709*0	2.1187*0	7.5800*3	679.8660*3
		3.0000*6	5.6845*0	3.4388*0	2.2115*0	4.1400*3	703.2420*3
		4.0000*6	4.8995*0	2.6828*0	2.2150*0	1.6900*3	691.7420*3
		6.0000*6	4.2410*0	2.1198*0	2.1268*0	410.0000*6	636.3550*3
		8.0000*6	4.4068*0	2.2843*0	2.1223*0	130.0000*6	717.3560*3
		10.0000*6	4.6667*0	2.6177*0	2.0489*0	40.0000*6	799.0330*3
		11.0000*6	4.7607*0	2.7478*0	2.0128*0	30.0000*6	828.3640*3
		12.0000*6	4.8356*0	2.8385*0	1.9972*0	20.0000*6	850.4030*3
		15.0000*6	4.9728*0	2.8997*0	2.0731*0		887.3700*3
CROSS SECTION FOR EXCITATION OF LEVELS							
ENERGY(EV)	1-ST	2-ND	3-TH	4-TH	5-TH	6-TH	7-TH
251.6660*3	0.0 +0						
300.0000*3	223.4000*3						
400.0000*3	357.4690*3						
411.2500*3	362.1752*3	0.0 +0					
500.0000*3	399.3020*3	62.7324*3					
600.0000*3	438.3210*3	96.61273*3					
613.1470*3	438.2663*3	99.02073*3	0.0 +0				
700.0000*3	437.9050*3	114.9100*3	101.0610*3				
785.8280*3	446.9805*3	131.8879*3	144.6748*3	0.0 +0			
800.0000*3	448.4790*3	134.6880*3	151.8730*3	101.7550*3			
900.0000*3	456.7370*3	154.4550*3	186.6830*3	240.4930*3			
989.0350*3	464.9184*3	168.9870*3	211.6564*3	295.0403*3	0.0 +0		
1.0000*6	465.9260*3	170.7710*3	214.7320*3	301.7580*3	3.0818*3		
1.0705*6	467.4420*3	178.8845*3	230.2107*3	328.3008*3	6.5843*3	0.0 +0	
1.2500*6	471.2990*3	199.5240*3	269.5900*3	395.8220*3	15.4950*3	24.0919*3	
1.5000*6	441.8120*3	201.6560*3	294.6390*3	466.2420*3	24.7179*3	57.6535*3	
1.6331*6	426.6103*3	201.5421*3	301.1177*3	488.0726*3	30.5965*3	70.6804*3	0.0 +0
1.7127*6	417.5208*3	201.4739*3	304.9915*3	501.1019*3	34.1115*3	78.4704*3	1.6715*3
1.7500*6	413.2610*3	201.4470*3	306.8070*3	507.2000*3	35.7588*3	87.1799*3	2.4549*3
2.0000*6	302.3630*3	160.5770*3	242.3200*3	333.2010*3	38.0692*3	85.0072*3	3.5103*3
2.5000*6	129.1100*3	77.7344*3	111.4670*3	124.3530*3	25.5725*3	53.8439*3	3.9087*3
3.0000*6	55.6475*3	35.8958*3	49.3851*3	51.8508*3	13.6940*3	27.5639*3	3.3658*3
4.0000*6	12.8743*3	8.8186*3	11.8595*3	12.5219*3	3.8550*3	7.4026*3	2.2478*3
6.0000*6	1.0242*3	714.5719*6	954.1190*6	1.1043*3	331.9850*6	626.7130*6	614.6750*6
8.0000*6							
10.0000*6							
11.0000*6							
12.0000*6							
15.0000*6							

TABLE A2 - 18

NUCLEUS ... 55-CS-137

PARAMETERS		CROSS SECTION(BARN) AND MU-BAR					
		ENERGY(EV)	TOTAL	ELASTIC	INELASTIC	CAPTURE	MU-BAR
NEUTRON SEPARATION ENERGY	4.871E 00(MEV)	100.0000*0	78.9368*0	77.0268*0	1.9100*0	4.9231*3	
LEVEL PARAMETER(XI=ZERO)	2.801E 04	300.0000*0	86.8758*0	86.1858*0	688.0000*3	4.9829*3	
LEVEL SPACING .....	1.100E 03(MEV)	1.0000*3	27.0810*0	26.8070*0	274.0000*3	5.3360*3	
LEVEL DENSITY PARAMETER ..	1.117E 01(1/MEV) TAG.	3.0000*3	16.9735*0	16.8345*0	139.0000*3	6.9294*3	
PAIRING ENERGY .....	8.500E 01(MEV) TAG.	10.0000*3	10.7703*0	10.7138*0	56.5000*3	15.1709*3	
PAIRING ENERGY .....	0.0 (MEV) COM.						
NORMALIZATION FACTOR .....	1.375E 03(1/MEV) TAG.	20.0000*3	8.5996*0	8.5669*0	32.7000*3	29.5799*3	
TANGENCY POINT .....	4.445E 00(MEV) TAG.	50.0000*3	6.7220*0	6.7038*0	18.2000*3	75.8294*3	
ADOPTED LEVELS (MEV)	3.587E 00(MEV) COM.	100.0000*3	5.8557*0	5.8440*0	11.7000*3	144.6980*3	
		200.0000*3	5.4434*0	5.4357*0	7.6600*3	238.6060*3	
		300.0000*3	5.4652*0	5.4585*0	6.7000*3	288.9720*3	
L. GROUND	7/2+	400.0000*3	5.6232*0	5.6168*0	6.4300*3	314.5440*3	
1. 0	5/2*	458.3500*3	5.7435*0	5.7371*0	6.3134*3	327.8011*3	
2. 0	4/2*	500.0000*3	5.8293*0	5.8154*0	168.9630*3	6.2400*3	337.2640*3
3. 0	3/2*	600.0000*3	6.0447*0	5.7457*0	292.7340*3	6.2800*3	352.1660*3
4. 0	2/2*	700.0000*3	6.2491*0	5.8750*0	367.5680*3	6.4700*3	362.5770*3
5. 0	1/2*						
6. 1	8/7-	800.0000*3	6.4309*0	5.9950*0	429.2000*3	6.7000*3	372.6110*3
7. 2	7/2-	856.2580*3	6.5171*0	6.3533*0	474.8940*3	6.8318*3	379.6781*3
8. 2	3/2*	900.0000*3	6.5841*0	6.0667*0	510.4290*3	6.9300*3	385.1730*3
9. 2	1/2*	987.2150*3	6.6905*0	6.0965*0	586.8480*3	7.1228*3	397.7956*3
		1.0000*6	6.7061*0	6.1009*0	598.0500*3	7.1500*3	399.6460*3
		1.2500*6	6.8773*0	6.0632*0	808.2560*3	7.8600*3	440.1790*3
		1.5000*6	6.8886*0	5.9321*0	947.7220*3	8.7300*3	478.2520*3
		1.5010*6	6.8882*0	5.9313*0	944.1050*3	8.7343*3	478.3748*3
		1.7500*6	6.7899*0	5.7336*0	1.0464*0	9.8100*3	509.9110*3
		1.8838*6	6.7016*0	5.5638*0	1.1281*0	9.6880*3	526.7023*3
		2.0000*6	6.6749*0	5.4162*0	1.1991*0	9.5900*3	541.2920*3
		2.0852*6	6.5929*0	5.2567*0	1.2889*0	7.3183*3	554.7847*3
		2.1658*6	6.4849*0	5.1055*0	1.3538*0	5.7246*3	567.5412*3
		2.2162*6	6.4424*0	5.0104*0	1.4070*0	4.5325*3	575.5143*3
		2.5000*6	6.2027*0	4.4734*0	1.7271*0	2.2600*3	620.4370*3
		3.0000*6	5.7511*0	3.6745*0	2.0752*0	960.0000*6	676.0150*3
		4.0000*6	4.9739*0	2.7832*0	2.1904*0	340.0000*6	689.3680*3
		6.0000*6	4.2802*0	2.1435*0	2.1366*0	100.0000*6	656.6480*3
		8.0000*6	4.4104*0	2.2792*0	2.1309*0	40.0000*6	715.4460*3
		10.0000*6	4.6605*0	2.6059*0	2.0546*0	20.0000*6	797.4440*3
		11.0000*6	4.7605*0	2.7384*0	2.0221*0	10.0000*6	827.0150*3
		12.0000*6	4.8464*0	2.8341*0	2.0123*0	10.0000*6	849.3800*3
		15.0000*6	5.0153*0	2.9173*0	2.0980*0		887.4590*3
CROSS SECTION FOR EXCITATION OF LEVELS							
ENERGY(EV)	1-ST	2-ND	3-TH	4-TH	5-TH	6-TH	7-TH
458.3500*3	0.0 +0						
500.0000*3	168.9630*3						
600.0000*3	292.7340*3						
700.0000*3	367.5680*3						
800.0000*3	429.2000*3						
856.2580*3	451.4022*3	0.0 +0					
900.0000*3	468.6650*3	41.7635*3					
987.2150*3	491.5355*3	67.0111*3	0.0 +0				
1.0000*6	494.9410*3	70.7122*3	32.4264*3				
	539.1330*3	113.6320*3	153.4900*3				
1.5000*6	564.1300*3	155.5020*3	224.0910*3				
1.5010*6	564.1075*3	155.6138*3	228.3323*3	0.0 +0			
1.7500*6	558.3330*3	184.3120*3	290.2700*3	13.5211*3			
1.8838*6	562.5225*3	191.9108*3	311.1354*3	19.4547*3	0.0 +0		
2.0000*6	528.7850*3	202.2510*3	329.2650*3	24.6103*3	113.5150*3		
2.0852*6	499.0799*3	196.4832*3	319.0364*3	27.0657*3	124.0863*3	0.0 +0	
2.1655*6	470.9952*3	191.0299*3	309.3657*3	29.3871*3	134.0809*3	6.0516*3	0.0 +0
2.2162*6	453.4419*3	187.6716*3	303.3214*3	30.8380*3	140.3277*3	9.8340*3	1.3341*3
2.5000*6	354.5410*3	164.4180*3	269.2660*3	39.0129*3	175.5240*3	31.1449*3	8.8508*3
3.0000*6	154.0060*3	46.2665*3	126.9860*3	28.1148*3	108.0590*3	35.9521*3	13.9097*3
4.0000*6	34.8612*3	22.2199*3	30.5596*3	9.1532*3	36.2669*3	14.5705*3	6.9348*3
6.0000*6	3.5418*3	2.3559*3	3.1783*3	1.0735*3	5.5767*3	1.8068*3	922.0811*6
8.0000*6	562.4190*6	373.1280*6	507.1480*6	168.6470*6	846.0371*6	283.8170*6	144.6850*6
10.0000*6							
11.0000*6							
12.0000*6							
15.0000*6							

TABLE A2 - 19

NUCLEUS :: 58-CF-144

PARAMETERS	CROSS SECTION(BARN) AND MU-BAR					
	ENERGY(EV)	TOTAL	ELASTIC	INELASTIC	CAPTURE	MU-BAR
NEUTRON SEPARATION ENERGY 4.581E 00(MEV)						
LEVEL PARAMETER(X1-ZERO) . 3.530E 03	100.0000+0	125.2810+0	121.6210+0		3.6600+0	4.6783+3
LEVEL SPACING ..... 1.000E 03(MEV)	300.0000+0	73.3614+0	72.0914+0		1.2700+0	4.7134+3
LEVEL DENSITY PARAMETER ** 1.890E 01(1/MEV) TAG*	1.0000+3	41.2763+0	40.8313+0		445.0000+3	4.9256+3
1.973E 01(1/MEV) COM*	3.0000+3	24.8529+0	24.6199+0		233.0000+3	5.9187+3
PAIRING ENERGY ..... 2.090E 00(MEV) TAG.	10.0000+3	14.6989+0	14.5535+0		145.0000+3	11.3616+3
1.170E 00(MEV) COM.						
NORMALIZATION FACTOR .... 2.445E 03(1/MEV) TAG.	20.0000+3	11.0911+0	10.9891+0		102.0000+3	21.4436+3
TANGENCY POINT ..... 5.632E 00(MEV) TAG.	50.0000+3	7.9002+0	7.8279+0		72.3000+3	56.1963+3
4.704E 00(MEV) COM.	100.0000+3	6.3956+0	6.2934+0		62.7000+3	112.0130+3
	200.0000+3	5.5035+0	5.4556+0		44.5000+3	192.9980+3
	300.0000+3	5.3922+0	5.3485+0		43.7000+3	237.7100+3
ADOPTED LEVELS (MEV)						
1. GROUND 0+	400.0000+3	5.5254+0	5.4813+0		44.1000+3	260.9290+3
2. 0.3975 2+	400.2840+3	5.4421+0	0.0	43.8737+3	261.1041+3	
3. 0.80 4+	500.0000+3	5.1561+0	4.8734+0	*64.3780+3	322.5970+3	
	600.0000+3	6.0182+0	4.9030+0	1.0990+0	16.3000+3	346.0580+3
	700.0000+3	6.2759+0	4.9835+0	1.2762+0	16.3000+3	370.7230+3
800.0000+3	6.5092+0	5.0703+0	1.4223+0		16.8000+3	393.4180+3
805.6040+3	6.5203+0	5.0746+0	1.4280+0		16.7390+3	395.1783+3
900.0000+3	6.7076+0	5.1457+0	1.5656+0		15.8000+3	418.0920+3
1.0000+6	6.8676+0	5.2023+0	1.6494+0		15.9000+3	443.3320+3
1.0070+6	6.8743+0	5.2026+0	1.6559+0		15.8841+3	445.2053+3
1.2500+6	7.1071+0	5.2115+0	1.8802+0		15.4000+3	510.2360+3
1.5000+6	7.1625+0	5.1209+0	2.0268+0		14.7000+3	570.1630+3
1.7500+6	7.0943+0	4.9725+0	2.1079+0		13.9000+3	617.7360+3
2.0000+6	6.9487+0	4.7844+0	2.1513+0		13.1000+3	653.2170+3
2.5000+6	6.5382+0	4.3452+0	2.1823+0		10.7000+3	694.8560+3
3.0000+6	6.0792+0	3.8887+0	2.1824+0		8.1400+3	708.8490+3
4.0000+6	5.2553+0	3.0981+0	2.1534+0		3.8000+3	694.6020+3
6.0000+6	4.4081+0	2.3436+0	2.0639+0	570.0000+6	632.5290+3	
8.0000+6	4.4796+0	2.2678+0	2.1617+0	80.0000+6	710.6880+3	
10.0000+6	4.6467+0	2.5667+0	2.0800+0	20.0000+6	790.0290+3	
11.0000+6	4.7720+0	2.7086+0	2.0633+0	10.0000+6	820.2120+3	
12.0000+6	4.9012+0	2.8257+0	2.0755+0		843.8710+3	
15.0000+6	5.1575+0	2.9952+0	2.1623+0		886.0660+3	

## CROSS SECTION FOR EXCITATION OF LEVELS

ENERGY(EV)	1-ST	2-ND	3-TH
400.2840+3	0.0 +0		
500.0000+3	864.8780+3		
600.0000+3	1.0990+0		
700.0000+3	1.2761+0		
800.0000+3	1.4221+0		
805.6040+3	1.4273+0	0.0 +0	
900.0000+3	1.5162+0	79.4244+3	
1.0000+6	1.5854+0	63.7965+3	
1.0070+6	1.5818+0	67.3673+3	
1.2500+6	1.5265+0	191.2170+3	
1.3000+6	1.3054+0	297.2470+3	
1.7500+6	1.0505+0	334.7470+3	
2.0000+6	820.3940+3	320.8940+3	
2.5000+6	503.7080+3	293.3260+3	
3.0000+6	352.9430+3	216.4360+3	
4.0000+6	271.0430+3	232.2950+3	
6.0000+6	352.6920+3	405.6350+3	
8.0000+6			
10.0000+6			
11.0000+6			
12.0000+6			
15.0000+6			

TABLE A2 - 20  
NUCLEUS ... 60-ND-143

PARAMETERS	CROSS SECTION(BARNS) AND MU-BAR					
	ENERGY(EV)	TOTAL	ELASTIC	INELASTIC	CAPTURE	MU-BAR
NEUTRON SEPARATION ENERGY 7.831E 00(MEV)						
LEVEL PARAMETER(X1=ZERO) 1.072E 03	100.0000+0	119.0410+0	83.7410+0	35.3000+0	4.7115+3	
LEVEL SPACING ..... 4.000E 01(MEV)	300.0000+0	69.7799+0	56.3799+0	13.4000+0	4.7447+3	
LEVEL DENSITY PARAMETER .. 1.820E 01(1/MEV)	1.0000+3	34.3408+0	34.3708+0	4.4700+0	4.9728+3	
PAIRING ENERGY ..... 1.180E 00(MEV)	3.0000+3	23.7638+0	22.0038+0	1.6800+0	6.0179+3	
1.940E 00(MEV)	10.0000+3	14.1382+0	13.4542+0	684.0000+3	11.7193+3	
NORMALIZATION FACTOR .... 2.337E 03(1/MEV)	20.0000+3	10.7224+0	10.2664+0	456.0000+3	22.2323+3	
TANGENCY POINT ..... 4.729E 00(MEV)	50.0000+3	7.7072+0	7.4322+0	275.0000+3	58.2545+3	
5.482E 00(MEV)	100.0000+3	6.2544+0	6.0574+0	197.0000+3	115.7110+3	
200.0000+3	5.4631+0	5.3101+0	153.0000+3	198.5030+3		
300.0000+3	5.3726+0	5.2376+0	135.0000+3	243.9730+3		
ADOPTED LEVELS (MEV)						
1. GROUND 7/2-	400.0000+3	5.5125+0	5.3865+0	126.0000+3	287.3860+3	
2. 0.742 3/2-	500.0000+3	5.6200+0	5.6172+0	124.0000+3	280.5730+3	
3. 2.736 9/2-	600.0000+3	5.7043+0	5.8783+0	126.0000+3	290.4860+3	
4. 1.311 1/2-	700.0000+3	6.2396+0	6.1796+0	130.0000+3	300.6220+3	
5. 1.412 13/2+	747.2340+3	6.3688+0	6.2373+0	0.0 +0	131.4385+3	308.3726+3
6. 1.560 5/2-	800.0000+3	6.4907+0	6.2633+0	133.0000+3	317.0310+3	
7. 1.744 7/2-	900.0000+3	6.6764+0	6.4079+0	140.6720+3	139.0000+3	332.7210+3
8. 1.857 3/2-	1.0000+6	6.7465+0	6.5216+0	117.8590+3	147.0000+3	349.2710+3
9. 1.916 7/2-	1.2447+6	7.0749+0	6.5741+0	136.6870+3	168.5535+3	395.7913+3
	1.2500+6	7.0843+0	6.5753+0	340.0650+3	169.0000+3	396.7950+3
1.7533+6	7.0648+0	5.8395+0	1.0781+0	147.1290+3	517.6092+3	
1.8701+6	6.9973+0	5.6074+0	1.2593+0	129.9912+3	555.8718+3	
1.9295+6	6.9620+0	5.4958+0	1.3539+0	127.2427+3	560.4966+3	
1.9632+6	6.9418+0	5.4150+0	1.4086+0	118.1497+3	568.9234+3	
2.0000+6	6.9204+0	5.3397+0	1.4667+0	114.0000+3	577.8490+3	
2.5000+6	6.5066+0	4.3144+0	2.1691+0	23.1000+3	694.1780+3	
3.0000+6	6.0453+0	3.7826+0	2.2537+0	8.0500+0	721.7290+3	
4.0000+6	5.2230+0	2.9867+0	2.2340+0	2.7500+3	711.8820+3	
6.0000+6	3.3897+0	2.2175+0	2.1718+0	400.0000+6	663.0580+3	
8.0000+6	4.4235+0	2.2669+0	2.1566+0	70.0000+6	710.3930+3	
10.0000+6	4.6647+0	2.5703+0	2.0744+0	20.0000+6	790.4160+3	
11.0000+6	4.7672+0	2.7117+0	2.0555+0	10.0000+6	820.6390+3	
12.0000+6	4.8920+0	2.6268+0	2.0651+0	10.0000+6	844.2220+3	
15.0000+6	5.1429+0	2.9848+0	2.1544+0		886.0780+3	

## CROSS SECTION FOR EXCITATION OF LEVELS

ENERGY(EV)	1-ST	2-ND	3-TH	4-TH	5-TH	6-TH	7-TH	8-TH
747.2340+3	0.0 +0							
800.0000+3	94.4246+3							
900.0000+3	140.6720+3							
1.0000+6	177.8590+3							
1.2447+6	270.3074+3	0.0 +0						
1.2500+6	272.3020+3	67.7841+3						
1.3203+6	288.5730+3	144.7075+3						
1.4220+6	312.1307+3	256.0807+3	12.2270+0	0.0 +0				
1.5000+6	330.2060+3	361.5340+3	21.6085+3	60.4941+3				
1.5710+6	329.0016+3	373.7535+3	27.1732+3	84.7735+3	0.0 +0			
1.7500+6	325.9650+3	454.9830+3	41.2025+3	145.9850+3	101.4760+3			
1.7553+6	324.5713+3	454.7836+3	41.4339+3	146.3873+3	102.1338+3	0.0 +0		
1.8701+6	294.3244+3	450.4567+3	46.4551+3	155.1174+3	116.4112+3	56.3977+3	0.0 +0	
1.9295+6	278.6727+3	448.2176+3	49.0539+3	159.6349+3	123.7991+3	55.5815+3	11.9093+3	0.0 +0
1.9638+6	269.6521+3	446.9772+3	50.5909+3	162.2346+3	128.0371+3	102.4040+3	18.7730+3	27.0653+3
2.0000+6	260.1020+3	445.5610+3	52.1363+3	164.9950+3	132.5650+3	120.2080+3	26.0397+3	55.7195+3
2.5000+6	78.8469+3	121.5677+3	25.8963+3	72.5116+3	69.1751+3	70.8700+3	27.8534+1	53.4354+3
3.0000+6	25.1071+3	38.0285+3	9.7244+3	31.8220+3	26.2371+3	28.9666+3	14.2732+3	25.3465+3
4.0000+6	4.2698+3	6.4125+3	1.8405+3	7.5055+3	4.7350+3	5.3553+3	2.9669+3	5.0529+3
6.0000+6	219.8711+6	346.0090+6	98.2a30+6	562.8460+6	247.6590+6	283.3110+6	163.3700+6	270.3820+6
8.0000+6								
10.0000+6								
11.0000+6								
12.0000+6								
15.0000+6								

JAERI-M 5752

TABLE A2 - 21  
NUCLEUS ... 60-ND-144

PARAMETERS		CROSS SECTION(MBARN) AND MU-BAR					
		ENERGY(EV)	TOTAL	ELASTIC	INELASTIC	CAPTURE	MU-BAR
NEUTRON SEPARATION ENERGY	5.741E 00(MEV)						
LEVEL PARAMETER(XI-ZERO)	2.387E 03						
LEVEL SPACING	6.000E 02(MEV)	100.0000+0	125.2810+0	119.9510+0		5.3300+0	4.6783-3
LEVEL DENSITY PARAMETER	1.917E 01(1/MEV)	300.0000+0	73.3614+0	71.5214+0		1.8400+0	1.7134-3
PAIRING ENERGY	1.940E 00(MEV)	1.0000+3	41.2763+0	40.6543+0		622.0000+3	4.9256-3
NORMALIZATION FACTOR	2.442E 00(MEV)	2.0002	01(1/MEV) TAG.	3.0000+3	24.8529+0	24.5539+0	299.0000+3
TANGENCY POINT	4.714E 00(MEV)	1.0000+3	00(1/MEV) COM.	10.0000+3	14.6985+0	14.5125+0	186.0000+3
ADOPTED LEVELS (MEV)							
1.	GROUN	0+	400.0000+0	5.5254+0	5.4647+0		60.7000-3
2.	0.6964	2+	500.0000+0	5.7561+0	5.6920+0		64.1000-3
3.	1.3145	4+	600.0000+0	6.0182+0	5.9480+0		70.3000-3
4.	1.5099	3-	700.0000+0	6.2759+0	6.1974+0		78.6000-3
5.	1.5600	7+	701.2780+3	6.2789+0	6.2008+0	0.0	78.1029+3
6.	1.738	2+	800.0000+0	6.5092+0	5.5288+0	93.0.9400+3	49.4000-3
7.	1.7902	6+	900.0000+0	6.7076+0	5.5418+0	1.1211+0	44.8000-3
8.	2.085	0+	1.0000+6	6.8676+0	5.5704+0	1.2544+0	43.1000-3
9.	2.11	2-	1.2500+6	7.1071+0	5.5594+0	1.5024+0	45.5000-3
10.	2.1856	1-	1.3237+6	7.1235+0	5.5280+0	1.9505+0	44.9588+3
			1.5000+6	7.1625+0	5.4326+0	1.6661+0	43.8000-3
			1.5205+6	7.1569+0	5.4293+0	1.6843+0	43.2959+3
			1.5709+6	7.1431+0	5.3719+0	1.7291+0	42.1063+3
			1.7300+6	7.0943+0	5.1674+0	1.8884+0	38.4000-3
			1.7502+6	7.0942+0	5.1673+0	1.8885+0	38.3983+3
			1.8027+6	7.0636+0	5.1082+0	1.9175+0	37.8762+3
			2.0000+6	6.9287+0	4.8862+0	2.0264+0	36.1000-3
			2.0996+6	6.8669+0	4.7769+0	2.0559+0	34.1032+3
			2.1248+6	6.8463+0	4.7493+0	2.0634+0	33.6305+3
			2.2009+6	6.7638+0	4.6656+0	2.0859+0	32.2726+3
			2.2154+6	6.7713+0	4.6696+0	2.0902+0	32.0225+3
			2.5000+6	6.5382+0	4.3356+0	2.1748+0	27.8000-3
			3.0000+6	6.0782+0	3.8245+0	2.2402+0	14.5000-3
			4.0000+6	5.2553+0	3.0166+0	2.2341+0	4.5800-3
			6.0000+6	4.4081+0	2.2301+0	2.1774+0	600.0000-6
			8.0000+6	4.4296+0	2.2678+0	2.1617+0	90.0000-6
			10.0000+6	4.6467+0	2.5667+0	2.0800+0	20.0000-6
			11.0000+6	4.7720+0	2.7086+0	2.0633+0	10.0000-6
			12.0000+6	4.9012+0	2.8257+0	2.0755+0	843.8710-3
			15.0000+6	5.1575+0	2.9952+0	2.1623+0	886.0660-3

CROSS SECTION FOR EXCITATION OF LEVELS

ENERGY(EV)	1-ST	2-ND	3-TH	4-TH	5-TH	6-TH	7-TH	8-TH	9-TH
701.2780+3	0.0 *0								
800.0000+3	930.9400+3								
900.0000+3	1.1211+0								
1.0000+6	1.2564+0								
1.2300+6	1.5022+0								
1.3237+6	1.5204+0	0.0 *0							
1.5000+6	1.5640+0	102.1390+3							
1.5205+6	1.5394+0	109.2040+3	0.0 *0						
1.5709+6	1.4790+0	126.6079+3	30.2469+3	0.0 *0					
1.7500+6	1.2645+0	188.3870+3	137.6070+3	297.9270+3					
1.7502+6	1.2643+0	188.4376+3	137.6501+3	297.9559+3	0.0 *0				
1.8027+6	1.2052+0	205.6343+3	190.9886+3	306.8882+3	47.7425+3	0.0 *0			
2.0000+6	983.5400+3	270.1620+3	201.0390+3	340.4050+3	226.8880+3	3.8907+3			
2.0996+6	886.8890+3	265.5248+3	107.0504+3	332.6651+3	229.8981+3	8.4085+3	0.0 *0		
2.1248+6	862.4345+3	264.3525+3	106.0466+3	330.7084+3	230.6551+3	9.5506+3	2.8616+1	0.0 *0	
2.2009+6	788.5786+3	260.8000+3	193.0006+3	324.7923+3	232.9599+3	13.0038+3	11.5135+3	16.1100+3	0.0 *0
2.2154+6	774.5079+3	260.1979+3	107.4204+3	323.6655+3	233.3981+3	13.6615+3	13.1634+3	19.1784+3	3.3304+3
2.5000+6	498.3440+3	266.8A30+3	181.0380+3	301.5500+3	241.9990+3	26.5702+3	45.5041+3	79.4011+3	68.6949+3
3.0000+6	185.1300+3	108.3280+3	90.0283+3	142.2780+3	128.8470+3	20.3698+3	31.9273+3	63.5057+3	51.6628+3
4.0000+6	25.8217+3	18.7921+3	18.1064+3	22.1115+3	21.2852+3	5.6476+3	5.8266+3	19.7451+3	12.3509+3
6.0000+6	747.8660+6	719.4122+6	841.2851+6	669.6088+6	652.7742+6	369.3050+6	167.4130+6	670.5220+6	469.4441+6
8.0000+6									
10.0000+6									
12.0000+6									
15.0000+6									

TABLE A2 - 22

NUCLEUS ... 60-ND-145

PARAMETERS	CROSS SECTION(BAHN) AND MU-BAR				
	ENERGY(EV)	TOTAL	ELASTIC	INELASTIC	CAPTURE
NEUTRON SEPARATION ENERGY 7.561E 00(MEV)	100.0000+0	134.1040+0	88.9040+0	45.2000+0	4.6455-3
LEVEL PARAMETFR(XI=ZERO) .7.958E 02	300.0000+0	78.4076+0	61.0075+0	17.4000+0	4.6781-3
LEVEL SPACING ..... 2.500E 01(MEV)	1.0000+3	43.9868+0	38.1268+0	5.8600+0	4.8756-3
LEVEL DENSITY PARAMETFR .. 1.683E 01(MEV) TAG.	3.0000+3	26.3600+0	24.1800+0	2.1800+0	5.8015-3
PAIRING ENERGY ..... 1.764E 01(MEV) COM.	10.0000+3	15.4593+0	14.6163+0	843.0000-3	10.9020-3
PAIRING ENERGY ..... 2.100E 00(MEV) COM.	20.0000+3	11.3841+0	11.0341+0	550.0000-3	20.4011-3
NORMALIZATION FACTOR .... 2.192E 03(MEV) TAG.	50.0000+3	8.1475+0	7.8105+0	337.0000-3	53.4253-3
TANGENCY PCINT ..... 4.714E 00(MEV) TAG.	67.4461+3	7.5645+0	7.2876+0	0.0 +0	276.3404-3
5.627E 00(MEV) COM.	72.5009+3	7.3965+0	7.0442+0	88.1319+3	75.8199-3
ADOPTED LEVELS (MEV)	100.0000+3	6.4748+0	5.6929+0	571.8720+3	214.0000-3
1. GROUND 7/2-	200.0000+3	5.5439+0	4.7406+0	648.3850+3	155.0000-3
2. 0.067 3/2-	300.0000+3	5.4063+0	4.5607+0	711.5970+3	134.0000-3
3. 0.072 5/2-	400.0000+3	5.5321+0	4.6110+0	798.0840+3	123.0000-3
4. 0.749 5/2-	500.0000+3	5.7639+0	4.7572+0	884.7140+3	118.0000-3
5. 0.92 9/2-	600.0000+3	6.0304+0	4.9409+0	972.4690+3	117.0000-3
6. 1.054 3/2-	700.0000+3	6.2932+0	5.1308+0	1.0433+0	119.0000-3
7. 1.155 9/2+	754.2100+3	6.4220+0	5.2128+0	1.0818+0	121.2181-3
8. 1.39 7/2-	800.0000+3	6.5309+0	5.2821+0	1.1259+0	123.0000-3
9. 0.0000+3	900.0000+3	6.7328+0	5.4149+0	1.1855+0	128.0000-3
10. 0.0000+3	926.4000+3	6.7758+0	5.4200+0	1.2289+0	126.8897-3
11. 0.0000+6	1.0000+6	6.8954+0	5.4214+0	1.3500+0	124.0000-3
12. 0.0000+6	1.0613+6	6.9552+0	5.4271+0	1.4062+0	121.8138-3
13. 0.0000+6	1.1630+6	7.0543+0	5.4360+0	1.4997+0	118.5273-3
14. 0.0000+6	1.2500+6	7.1309+0	5.4432+0	1.5798+0	116.0000-3
15. 0.0000+6	1.3997+6	7.1738+0	5.3481+0	1.7277+0	98.0076-3
16. 0.0000+6	1.4097+6	7.1762+0	5.3418+0	1.7277+0	96.0461-3
17. 0.0000+6	7.1971+0	5.2610+0	5.2610+0	1.8277+0	88.0000-3
18. 0.0000+6	1.7500+6	7.1316+0	4.9999+0	2.0827+0	49.1000-3
19. 0.0000+6	2.0000+6	6.9862+0	4.7588+0	2.1964+0	33.0000-3
20. 0.0000+6	2.3000+6	6.9815+0	4.7588+0	2.1964+0	66.7050-3
21. 0.0000+6	2.6000+6	6.9819+0	4.3037+0	2.2611+0	17.0000-3
22. 0.0000+6	3.0000+6	6.1254+0	3.8545+0	2.2604+0	10.5000-3
23. 0.0000+6	4.0000+6	5.7972+0	3.0602+0	2.2325+0	4.5200-3
24. 0.0000+6	6.0000+6	4.8280+0	2.2452+0	2.1820+0	830.0000-6
25. 0.0000+6	8.0000+6	4.4379+0	2.2660+0	2.1466+0	180.0000-6
26. 0.0000+6	10.0000+6	4.6446+0	2.5588+0	2.0858+0	90.0000-6
27. 0.0000+6	11.0000+6	4.7741+0	2.7016+0	2.0725+0	30.0000-6
28. 0.0000+6	12.0000+6	4.9095+0	2.8216+0	2.0879+0	20.0000-6
29. 0.0000+6	15.0000+6	5.1716+0	3.0021+0	2.1696+0	885.9600-3
CROSS SECTION FOR EXCITATION OF LEVELS					
ENERGY(EV)	1-ST	2-ND	3-TH	4-TH	5-TH
67.4661+3	0.0 +0				
72.5009+3	5.7457+3	0.0 +0			
100.0000+3	37.1275+3	534.7450+3			
200.0000+3	96.2419+3	552.1430+3			
300.0000+3	153.2580+3	558.3380+3			
400.0000+3	209.1720+3	588.9120+3			
500.0000+3	259.3940+3	629.3160+3			
600.0000+3	301.8750+3	670.5900+3			
700.0000+3	335.9640+3	707.3560+3			
754.2100+3	341.6308+3	708.3R93+3	0.0 +0		
800.0000+3	346.4140+3	709.2620+3	70.1869+3		
900.0000+3	355.4730+3	714.0220+3	115.9890+3		
926.4000+3	353.6907+3	700.1535+3	124.3058+3	0.0 +0	
1. 0000+6	344.7270+3	661.4900+3	147.4920+3	192.2510+3	
1. 0613+6	342.2337+3	642.3R82+3	162.7254+3	222.7639+3	0.0 +0
1. 1630+6	331.4800+3	610.7127+3	187.9860+3	273.3617+3	20.6465+3
1. 2500+6	372.2820+3	583.6250+3	209.5880+3	316.6310+3	38.3064+3
1. 3997+6	291.8715+3	516.8387+3	228.1504+3	342.0186+3	54.6564+3
1. 4097+6	289.8234+3	512.3452+3	229.3960+3	343.7267+3	55.7564+3
1. 5000+6	271.4860+3	472.0400+3	240.5930+3	359.0370+3	65.6164+3
1. 7500+6	198.8570+3	325.4200+3	207.6840+3	270.7740+3	78.1865+3
2. 0000+6	136.1650+3	212.1110+3	151.2970+3	194.0240+3	71.2431+3
2. 5000+6	59.9297+3	87.8516+3	70.1865+3	94.1153+3	10.4401+3
3. 0000+6	27.5217+3	36.1382+3	32.1907+3	37.6444+3	19.6738+3
4. 0000+6	6.4006+3	8.6R27+3	7.5016+3	8.7158+3	4.9073+3
6. 0000+6	417.7720+6	580.9621+6	48A.3260+6	595.7801+6	323.5780+6
8. 0000+6					944.4349+6
10. 0000+6					493.6371+6
11. 0000+6					
12. 0000+6					
15. 0000+6					

TABLE A2 - 23  
NUCLEUS ... 61-PM-147

PARAMETERS		CROSS SECTION(BARN) AND MU-BAR					
		ENERGY(EV)	TOTAL	ELASTIC	INELASTIC	CAPTURE	MU-BAR
NEUTRON SEPARATION ENERGY	5.881E 00(MEV)						
LEVEL PARAMETER(XI-ZERO)	1.614E 02						
LEVEL SPACING	5.700E 00(MEV)	100.0000+0	146.7930+0	47.9930+0	98.0000+0	4.5027+3	
LEVEL DENSITY PARAMETER	1.846E 01(1/MEV)	300.0000+0	86.0013+0	41.0013+0	45.0000+0	4.6164+3	
PAIRING ENERGY	1.929E 01(MEV)	1.0000+3	48.4349+0	30.7349+0	17.7000+0	4.8190+3	
NORMALIZATION FACTOR	2.438E 03(1/MEV)	1.929E 01(MEV)	1.0000+3	29.1777+0	22.0477+0	7.1300+0	5.7605+3
TANGENCY POINT	4.440E 00(MEV)	1.929E 01(MEV)	1.0000+3	17.2243+0	14.6043+0	2.6200+0	10.8764+3
ADOPTED LEVELS (MEV)							
1.	GROUND	7/2+	300.0000+3	5.7959+0	4.8316+0	538.3230+3	426.0000+3
2.	0.0911	5/2+	400.0000+3	5.8603+0	4.8578+0	592.4230+3	410.0000+3
3.	0.4105	3/2+	413.3170+3	5.8848+0	4.8615+0	616.2670+3	407.0017+3
4.	0.4893	7/2+	492.6570+3	6.0310+0	4.8799+0	759.7800+3	361.2953+3
5.	0.5310	5/2+	500.0000+3	6.0445+0	4.8813+0	773.1860+3	390.0000+3
6.	0.6804	3/2+	534.6440+3	6.1223+0	4.8840+0	858.7940+3	379.4684+3
7.	0.6859	5/2+	600.0000+3	6.1900+0	4.8842+0	1.0228+0	362.0000+3
			685.0590+3	6.4593+0	4.9504+0	1.1607+0	348.1946+3
			690.6060+3	6.4717+0	4.9546+0	1.1697+0	347.3736+3
			694.7350+3	6.4805+0	4.9577+0	1.1765+0	346.7669+3
			700.0000+3	6.4927+0	4.9616+0	1.1851+0	346.0000+3
			800.0000+3	6.6947+0	4.9264+0	1.4883+0	280.0000+3
			900.0000+3	6.8554+0	4.8969+0	1.7405+0	228.0000+3
			1.0000+6	7.0020+0	4.8949+0	1.9392+0	168.0000+3
			1.2500+6	7.2033+0	4.9017+0	2.1895+0	112.0000+3
			1.5000+6	7.2465+0	4.8959+0	2.2715+0	79.1000+3
			1.7500+6	7.1826+0	4.8451+0	2.2776+0	59.9000+3
			2.0000+6	7.0498+0	4.7466+0	2.2562+0	47.0000+3
			2.5000+6	6.6712+0	4.4355+0	2.2050+0	30.7000+3
			3.0000+6	6.2407+0	4.0488+0	2.1710+0	20.9000+3
			12.0000+6	5.0564+0	2.8889+0	2.1674+0	20.0000+6
			15.0000+6	5.3146+0	3.0720+0	2.2426+0	848.1420+3
							887.7220+3
CROSS SECTION FOR EXCITATION OF LEVELS							
ENERGY(EV)	1-ST	2-ND	3-TH	4-TH	5-TH	6-TH	
91.7251+3	0.0 +0						
100.0000+3	342.6497+3						
200.0000+3	504.2110+3						
300.0000+3	538.3230+3						
400.0000+3	592.4230+3						
413.3170+3	591.5699+3	0.0 +0					
492.6570+3	586.4874+3	58.2872+3	0.0 +0				
500.0000+3	586.0170+3	64.2717+3	122.8980+3				
534.6440+3	569.9228+3	71.5220+3	182.9260+3	0.0 +0			
600.0000+3	539.5610+3	85.1966+3	296.1690+3	101.8370+3			
685.0590+3	528.2162+3	96.1605+3	338.7392+3	131.2397+3	0.0 +0		
690.6060+3	527.4778+3	96.5779+3	341.5101+3	133.1537+3	6.3308+3	0.0 +0	
694.7350+3	526.9272+3	97.4059+3	343.5763+3	134.5810+3	11.0518+3	13.7509+3	
700.0000+3	526.2250+3	98.0843+3	346.2110+3	136.4010+3	17.0716+3	31.2811+3	
800.0000+3	483.4010+3	107.3770+3	358.8210+3	154.2940+3	36.7265+3	81.3797+3	
900.0000+3	435.4780+3	115.8810+3	352.0100+3	167.7700+3	47.0586+3	100.8140+3	
1.0000+6	389.8210+3	170.3940+3	339.8100+3	175.9610+3	55.8921+3	114.7840+3	
1.2500+6	279.8080+3	110.8710+3	283.8140+3	167.3500+3	67.6953+3	125.9820+3	
1.5000+6	202.1810+3	90.9172+3	225.4850+3	180.8640+3	66.0061+3	116.9330+3	
1.7500+6	157.1970+3	72.2044+3	178.8620+3	113.6470+3	57.3806+3	99.5414+3	
2.0000+6	122.2850+3	98.9546+3	147.8370+3	93.5494+3	48.6943+3	83.9232+3	
2.5000+6	94.7402+3	95.7042+3	117.7280+3	72.7334+3	36.3338+3	65.9499+3	
3.0000+6	88.1805+3	42.8755+3	110.6860+3	67.7079+3	36.0567+3	61.4838+3	
4.0000+6	99.3778+3	50.4072+3	123.5870+3	77.3956+3	42.9465+3	70.7705+3	
6.0000+6	154.2350+3	85.7652+3	195.4130+3	127.5960+3	75.7599+3	118.7600+3	
8.0000+6							
10.0000+6							
11.0000+6							
12.0000+6							
15.0000+6							

TABLE A2 - 24

NUCLEUS ... 62-5M=147

## PARAMETERS

	ENERGY(EV)	TOTAL	ELASTIC	INELASTIC	CAPTURE	MU-BAR
NEUTRON SEPARATION ENERGY	8.141E 00(MEV)					
LEVEL PARAMETER(X1-ZERO)	2.023F D2	100.0000+0	169.3080+0	44.0800+0	124.5000+0	4.5814+3
LEVEL SPACING .....	4.000E 00(MEV)	300.0000+0	98.9389+0	53.0349+0	45.9000+0	4.6100+3
LEVEL DENSITY PARAMETER ..	1.813E 01(1/MEV) TAG.	1.0000+3	55.4480+0	38.0480+0	17.4000+0	4.7824+3
PAIRING ENERGY .....	1.901E 01(1/MEV) COM.	3.0000+3	33.1451+0	26.3351+0	6.8100+0	5.5866+3
TANGENCY POINT .....	1.220E 00(MEV) TAG.	10.0000+3	19.2856+0	16.8556+0	2.4300+0	9.9872+3
NORMALIZATION FACTOR .....	2.400E 03(1/MEV) TAG.	20.0000+3	14.3102+0	12.9002+0	1.4100+0	18.1432+3
TANGENCY POINT .....	4.740E 00(MEV) TAG.	50.0000+3	9.8222+0	9.0232+0	799.0000+3	46.4270+3
5.654E 00(MEV) COM.	100.0000+3	7.5639+0	6.9666+0	597.0000+3	92.4176+3	
122.0320+3	7.2593+0	6.7127+0	0.0 +0	546.5405+3	111.0080+3	
198.7540+3	6.1986+0	5.2750+0	483.3320+3	440.2185+3	175.7447+3	
ADOPTED LEVELS (MEV)						
1. GROUND	7/2-	200.0000+3	6.1813+0	5.2512+0	491.1750+3	439.0000+3
2. 0.1212	5/2-	300.0000+3	5.8513+0	4.8914+0	565.8980+3	394.0000+3
3. 0.1474	3/2-	400.0000+3	5.8717+0	4.8413+0	657.3780+3	373.0000+3
4. 0.713	11/2-	500.0000+3	6.0345+0	4.9136+0	757.6770+3	363.0000+3
5. 0.7988	3/2-	600.0000+3	6.2482+0	5.0382+0	851.0160+3	359.0000+3
6. 0.808	13/2+	700.0000+3	6.4661+0	5.1774+0	927.7050+3	361.0000+3
7. 0.925	11/2+	717.8920+3	6.5017+0	5.1655+0	988.0349+3	348.1484+3
8. 1.007	1/2-	800.0000+3	6.6649+0	5.0951+0	1.2718+0	298.0000+3
9. 1.029	11/2+	800.4281+3	6.6722+0	5.0980+0	1.2768+0	297.3034+3
10. 1.054	5/2+	813.5440+3	6.6878+0	5.1042+0	1.2878+0	295.8143+3
11. 1.065	5/2+	900.0000+3	6.8341+0	5.1603+0	1.3908+0	283.0000+3
12. 1.077	7/2-	931.3470+3	6.8770+0	5.1751+0	1.4259+0	275.9975+3
13. 1.103	9/2-	1.0000+6	6.9709+0	5.2054+0	1.5035+0	262.0000+3
14. 1.166	11/2-	1.0139+6	6.9875+0	5.1946+0	1.5260+0	256.8395+3
15. 1.180	7/2-	1.0361+6	7.0009+0	5.1898+0	1.5621+0	248.9703+3
		1.0612+6	7.0218+0	5.1780+0	1.6034+0	240.5118+3
		1.0723+6	7.0310+0	5.1726+0	1.6213+0	236.5613+3
		1.0844+6	7.0411+0	5.1665+0	1.6344+0	233.1499+3
		1.1006+6	7.0629+0	5.1930+0	1.6847+0	225.2768+3
		1.1740+6	7.1157+0	5.1174+0	1.7903+0	207.9607+3
		1.1881+6	7.1274+0	5.1091+0	1.8139+0	204.4161+3
		1.2082+6	7.1422+0	5.0960+0	1.8478+0	192.5300+3
		1.2500+6	7.1789+0	5.0705+0	1.9184+0	190.0000+3
		1.3000+6	7.2364+0	4.9872+0	2.1172+0	132.0000+3
		1.7500+6	7.1906+0	4.9886+0	2.2064+0	98.0000+3
		2.0000+6	7.0769+0	4.7589+0	2.2435+0	78.5000+3
		2.5000+6	6.7342+0	4.2586+0	2.2598+0	65.7000+3
		3.0000+6	6.3298+0	4.0347+0	2.2639+0	31.1000+3
		4.0000+6	5.5410+0	3.2659+0	2.2617+0	13.4000+3
		6.0000+6	4.6306+0	2.3772+0	2.2511+0	2.2200+3
		8.0000+6	4.3380+0	2.3145+0	2.2231+0	410.0000+6
		10.0000+6	4.7203+0	2.5689+0	2.1513+0	100.0000+6
		11.0000+6	4.8673+0	2.7104+0	2.1519+0	30.0000+6
		12.0000+6	5.0181+0	2.8372+0	2.1899+0	30.0000+6
		15.0000+6	5.2954+0	3.0566+0	2.2388+0	885.8020+3

## CROSS SECTION FOR EXCITATION OF LEVELS

ENERGY(EV)	1-ST	2-ND	3-TH	4-TH	5-TH	6-TH	7-TH	8-TH	9-TH
122.0320+3	0.0 +0								
198.7540+3	467.8716+3	0.0 +0							
200.0000+3	475.4700+3	15.7058+3							
300.0000+3	491.4140+3	74.4819+3							
400.0000+3	532.2040+3	125.1740+3							
500.0000+3	582.1830+3	175.4940+3							
600.0000+3	629.5930+3	221.4230+3							
700.0000+3	667.6500+3	260.0580+3							
717.8920+3	667.8749+3	266.7200+3	0.0 +0						
800.0000+3	688.9070+3	297.3260+3	305.5260+3						
800.2810+3	688.6102+3	297.6421+3	307.6226+3	0.0 +0					
813.5440+3	667.9681+3	298.3291+3	312.1592+3	3.9207+3	0.0 +0				
900.0000+3	641.9750+3	304.7320+3	354.5010+3	40.5145+3	29.0521+3				
931.3470+3	659.1516+3	307.9110+3	389.5701+3	46.1000+3	34.9324+3	0.0 +0			
1.0000+6	632.9640+3	314.8860+3	370.6720+3	58.3328+3	47.8165+3	58.7381+3			
1.0139+6	642.1380+3	311.2379+3	368.4568+3	59.9302+3	49.0522+3	60.0302+3	0.0 +0		
1.0361+6	624.8924+3	305.4286+3	364.9294+3	62.4972+3	51.0198+3	62.0878+3	1.3926+3	0.0 +0	
1.0612+6	605.2956+3	298.8273+3	360.9210+3	65.4039+3	53.2557+3	64.4260+3	2.9751+3	0.5689+3	0.0 +0
1.0723+6	596.6689+3	295.9714+3	359.1565+3	66.6303+3	54.2369+3	65.4552+3	3.6714+3	9.4665+3	2.8786+3
1.0844+6	587.2637+3	292.7532+3	357.2327+3	68.0746+3	55.3130+3	66.5774+3	4.4313+3	12.6131+3	6.0171+3
1.1106+6	566.8804+3	285.8870+3	353.0635+3	71.1020+3	57.6347+3	69.0093+3	6.0773+3	19.4456+3	12.8108+3
1.1740+6	517.4951+3	269.2514+3	342.9622+3	78.4272+3	63.2733+3	74.9015+3	10.0653+3	35.9955+3	29.2982+3
1.1881+6	506.5171+3	265.5534+3	340.7167+3	80.0555+3	64.5258+3	76.2113+3	10.9518+3	39.6794+3	32.9615+3
1.2082+6	490.8443+3	260.2739+3	337.5110+3	82.3842+3	66.3140+3	78.0843+3	12.2174+3	44.9329+3	38.1913+3
1.2200+6	458.3230+3	249.3190+3	330.8590+3	87.2040+3	70.0245+3	81.9614+3	14.8436+3	55.8340+3	49.0434+3
1.5000+6	320.0900+3	188.5400+3	260.1570+3	98.4934+3	59.7006+3	77.3592+3	24.8970+3	62.1211+3	56.6448+3
1.7500+6	214.3840+3	132.8870+3	186.1790+3	97.3058+3	47.9367+3	64.5039+3	28.6738+3	56.0244+3	53.2008+3
2.0000+6	141.8340+3	91.2479+3	126.7460+3	67.8475+3	37.8011+3	51.1318+3	25.9786+3	46.5283+3	44.9722+3
2.5000+6	62.5475+3	42.2240+3	56.8402+3	34.6542+3	22.5395+3	29.5851+3	15.3104+3	28.0954+3	26.9976+3
3.0000+6	28.3424+3	19.6645+3	26.1140+3	16.6003+3	13.0570+3	16.3756+3	7.7664+3	15.7643+3	14.7385+3
4.0000+6	5.8092+3	4.1337+3	5.6880+3	3.6175+3	4.0493+3	4.7019+3	1.7764+3	4.5668+3	3.9939+3
6.0000+6	248.2010+6	176.4460+6	273.2479+6	158.2130+6	279.5590+6	301.2370+6	79.5308+6	297.5150+6	231.4760+6
8.0000+6									
10.0000+6									
11.0000+6									
12.0000+6									
15.0000+6									

TABLE A2 - 25

NUCLEUS ... 62-SM-149

PARAMETERS		CROSS SECTION(BARN) AND MU-BAR							
		ENERGY(EV)	TOTAL	ELASTIC	INELASTIC	CAPTURE	MU-BAR		
NEUTRON SEPARATION ENERGY	7.941E 00(MEV)								
LEVEL PARAMETER(X1-ZERO)	1.254E 02	100.0000+0	163.3730+0	32.3730+0		131.0000+0	4.5204-3		
LEVEL SPACING .....	3.200E 00(MEV)	300.0000+0	95.5599+0	39.2594+0		56.3000+0	5.5507-3		
LEVEL DENSITY PARAMETER ..	1.985E 01(1/MEV) TAG.	1.0000+3	53.6407+0	30.8407+0		22.8000+0	4.7327-3		
PAIRING ENERGY .....	2.046E 01(1/MEV) COM.	3.0000+3	32.1447+0	22.6947+0		9.4500+0	5.5804-3		
PAIRING ENERGY .....	1.722E 00(MEV) TAG.	10.0000+3	18.7874+0	15.2874+0		3.5000+0	10.2063-3		
NORMALIZATION FACTOR .....	2.210E 00(MEV) COM.	20.0000+3	13.9929+0	11.9729+0		2.0200+0	18.7554-3		
TANGENCY POINT .....	4.727E 00(MEV) TAG.	22.6523+3	13.6105+0	11.7843+0	0.0 +0	1.8263+0	21.8872-3		
.....	5.710E 00(MEV) COM.	50.0000+3	9.6695+0	7.7445+0	963.0710+3	962.0000+3	54.1789-3		
.....		100.0000+3	7.4976+0	6.0060+0	758.7560+3	678.0000+3	108.6300-3		
.....		200.0000+3	6.1784+0	4.9894+0	637.9480+3	551.0000+3	189.8250-3		
ADOPTED LEVELS (MEV)									
1. GROUND	7.2+-	279.0770+3	5.9392+0	4.6390+0	834.6890+3	472.4986+3	238.7484-3		
2. 0.0223	5.2+-	287.6340+3	5.8133+0	4.5511+0	856.2980+3	465.9612+3	244.0424-3		
3. 0.2771	5.2+-	300.0000+3	5.8759+0	4.5313+0	887.6290+3	457.0000+3	251.6930-3		
4. 0.2851	9.2+-	352.5710+3	5.8844+0	4.4444+0	1.0053+0	424.6899+3	274.1676-3		
5. 0.3102	5.2+-	400.0000+3	5.9111+0	4.3965+0	1.1133+0	401.0000+3	294.4440-3		
6. 0.398	1.2+-	400.6940+3	5.9123+0	4.3970+0	1.1145+0	400.8407+3	294.6374-3		
7. 0.5246	5.2+-	500.0000+3	6.0423+0	4.4576+0	1.2437+0	381.0000+3	322.3080-3		
8. 0.5593	5.2+-	532.1780+3	6.1526+0	4.4722+0	1.3121+0	368.2807+3	332.6671-3		
9. 0.568	9.2+-	562.0790+3	6.2179+0	4.4942+0	1.3762+0	357.4825+3	342.2931-3		
10. 0.640	5.2+-	569.8320+3	6.2348+0	4.4870+0	1.3930+0	354.8264+3	344.7890-3		
.....		600.0000+3	6.3007+0	4.4957+0	1.4585+0	345.0000+3	354.5010-3		
.....		644.3330+3	6.3984+0	4.5154+0	1.5556+0	327.3673+3	370.0131-3		
.....		654.4000+3	6.4206+0	4.5190+0	1.5779+0	323.6535+3	373.5356-3		
.....		700.0000+3	6.5211+0	4.5336+0	1.6795+0	308.0000+3	389.4910-3		
.....		800.0000+3	6.7208+0	4.5768+0	1.8750+0	269.0000+3	425.4000-3		
.....		900.0000+3	6.8899+0	4.6288+0	2.0211+0	240.0000+3	460.1420-3		
.....		1.0000+6	7.0258+0	4.6681+0	2.1437+0	198.0000+3	493.2410-3		
.....		1.2500+6	7.2290+0	4.7833+0	2.2947+0	151.0000+3	565.3760-3		
.....		1.5000+6	7.2794+0	4.8216+0	2.3348+0	123.0000+3	520.0080-3		
.....		1.7500+6	7.2255+0	4.7931+0	2.3311+0	101.0000+3	559.2170-3		
.....		2.0000+6	7.1036+0	4.7064+0	2.3136+0	83.5000+3	686.3710-3		
.....		2.5000+6	6.7457+0	4.4936+0	2.2851+0	56.9000+3	717.0780-3		
.....		3.0000+6	7.2290+0	4.7833+0	2.2774+0	39.6000+3	728.7820-3		
.....		4.0000+6	5.5339+0	3.2440+0	2.2734+0	16.5000+3	729.9470-3		
.....		6.0000+6	4.6545+0	2.3784+0	2.2648+0	2.3000+3	687.3670-3		
.....		8.0000+6	4.5774+0	2.3426+0	2.2344+0	360.0000+6	727.0190-3		
.....		10.0000+6	4.7736+0	2.6160+0	2.1635+0	80.0000+6	795.8090-3		
.....		11.0000+6	4.9181+0	2.7529+0	2.1556+0	40.0000+6	823.5710-3		
.....		12.0000+6	5.0736+0	2.8771+0	2.1059+0	20.0000+6	846.0960-3		
.....		15.0000+6	5.3337+0	3.0823+0	2.2514+0	8.0000+3	887.2220-3		
CROSS SECTION FOR EXCITATION OF LEVELS									
ENERGY(EV)	1-ST	2-ND	3-TH	4-TH	5-TH	6-TH	7-TH	8-TH	9-TH
22.6523+3	0.0 +0								
50.0000+3	963.0710+3								
100.0000+3	758.7560+3								
200.0000+3	637.9480+3								
279.0770+3	601.5059+3	0.0 +0							
287.6340+3	597.5610+3	13.4745+3	0.0 +0						
300.0000+3	591.8630+3	32.9670+3	262.8220+3						
352.5710+3	47.3477+3	366.2812+3	0.0 +0						
400.0000+3	560.4500+3	60.4160+3	459.6210+3	33.0695+3					
400.6940+3	360.4359+3	460.0987+3	33.2478+3	0.0 +0					
500.0000+3	558.4130+3	85.7908+3	528.4480+3	58.0394+3	13.0071+3				
532.1780+3	564.4040+3	92.2076+3	62.8428+3	14.8097+3	0.0 +0				
562.0790+3	531.3863+3	95.1884+3	527.9893+3	67.3063+3	12.0797+3	0.0 +0			
569.8320+3	328.0110+3	96.3621+3	527.9264+3	68.4636+3	16.9192+3	15.2118+3	11.1613+3	0.0 +0	
600.0000+3	314.8770+3	100.9290+3	527.7010+3	72.9670+3	18.3393+3	54.4935+3	141.4970+3		
644.3330+3	490.1166+3	106.4694+3	527.4421+3	79.5177+3	21.5562+3	33.1898+3	64.8693+3	177.2086+3	0.0 +0
654.4000+3	486.4941+3	108.3410+3	527.3533+3	81.0053+3	22.2254+3	34.5046+3	67.2254+3	165.3178+3	13.5355+3
700.0000+3	459.0260+3	114.5540+3	527.1170+3	87.7432+3	25.2566+3	40.4606+3	77.8977+3	222.0500+3	74.8465+3
800.0000+3	420.9080+3	126.2540+3	502.9070+3	101.5650+3	31.7277+3	53.0010+3	91.8807+3	246.4550+3	95.2119+3
900.0000+3	382.3940+3	132.0490+3	469.2570+3	110.6560+3	36.8727+3	64.3926+3	102.9200+3	254.6690+3	104.7950+3
1.0000+6	345.4380+3	133.1050+3	432.6690+3	115.3150+3	40.4983+3	73.8472+3	111.9200+3	256.2610+3	113.1220+3
1.2500+6	253.2510+3	117.5620+3	324.7310+3	107.7740+3	41.6849+3	82.3243+3	119.5980+3	230.1550+3	121.8910+3
1.5000+6	179.9320+3	93.4632+3	229.0290+3	88.3389+3	36.5141+3	74.6290+3	112.2760+3	162.8390+3	111.3710+3
1.7500+6	125.8120+3	70.2780+3	156.4190+3	67.4717+3	29.3169+3	60.1147+3	97.1914+3	133.7980+3	89.6577+3
2.0000+6	88.0913+3	51.6634+3	106.7030+3	49.9873+3	22.5825+3	45.7517+3	80.3220+3	94.6788+3	67.5159+3
2.5000+6	43.1220+3	26.8551+3	50.0210+3	26.1248+3	12.4988+3	24.3801+3	49.7186+3	45.5432+3	34.7897+3
3.0000+6	21.1079+3	19.6150+3	23.9337+3	13.2688+3	6.5907+3	12.4430+3	27.9472+3	21.8775+3	17.2154+3
4.0000+6	4.9970+3	3.3348+3	5.6865+3	3.2598+3	1.6745+3	3.0791+3	7.4545+3	5.2194+3	4.1421+3
6.0000+6	248.3476+6	192.3390+6	349.7790+6	188.3340+6	96.3804+6	178.6590+6	339.8120+6	321.5960+6	241.2110+6
8.0000+6	16.9142+6	11.6051+6	21.5824+6	11.4742+6	5.8878+6	11.1606+6	14.2918+6	20.6368+6	15.9991+6

TABLE A2 - 26  
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NUCLEUS ... 62-SM-151

PARAMETERS		CROSS SECTION(BARN) AND MU-BAR							
		ENERGY(EV)	TOTAL	ELASTIC	INELASTIC	CAPTURE	MU-BAR		
NEUTRON SEPARATION ENERGY	8.231E 00(MEV)								
LEVEL PARAMETER(XI-ZERO)	3.420E 01	100.0000+0	160.3780+0	140.5780+0	19.8000+0	4.4609-3			
LEVEL SPACING .....	1.300E 00(MEV)	300.0000+0	93.8589+0	82.4589+0	11.4000+0	4.4923-3			
LEVEL DENSITY PARAMETER	2.126E 01(1/MEV)	1.0000+3	52.7372+0	46.4072+0	6.3300+0	4.6809-3			
PAIRING ENERGY .....	1.132E 01(1/MEV) TAG, 1.220E 00(MEV) COM,	3.0000+3	31.6522+0	27.7022+0	3.9500+0	5.5583-3			
NORMALIZATION FACTOR .....	2.884E 03(1/MEV) TAG, 4.713E 00(MEV) TAG, 5.807E 00(MEV) COM,	10.0000+3	18.5507+0	12.9903+0	2.8504+0	2.7100+0	11.7162-3		
TANGENCY POINT .....	2.320E 00(MEV) COM,	20.0000+3	19.8482+0	20.0400+0	2.3400+0	22.6891-3			
ADOPTED LEVELS (MEV)		50.0000+3	9.6864+0	6.6250+0	1.2134+0	1.7700+0	59.4295-3		
1. GROUND	5/2-	168.8400+3	6.9164+0	6.0738+0	1.3944+0	1.4482+0	86.7990-3		
2. 0.00482	7/2-	66.2597+3	8.7051+0	5.9212+0	1.4387+0	1.3903+0	93.3736-3		
3. 0.06582	3/2-	70.1656+3	8.7051+0	5.9212+0	1.4387+0	1.3903+0	93.3736-3		
4. 0.06971	5/2-								
5. 0.09153	1/2+								
6. 0.10485	5/2-								
7. 0.16772	5/2+								
8. 0.16839	1/2+								
9. 0.20898	7/2-								
10. 0.20967	3/2+								
11. 0.32249	3/2+								
12. 0.34487	7/2+								
CROSS SECTION FOR EXCITATION OF LEVELS									
ENERGY(EV)	1-ST	2-ND	3-TH	4-TH	5-TH	6-TH	7-TH	8-TH	9-TH
4.8522+3	0.0 +0								
10.0000+3	2.8504+0								
20.0000+3	2.0400+0								
50.0000+3	1.2146+0								
66.2597+3	1.0585+0	0.0 +0							
70.1656+3	1.0213+0	39.3070+3	0.0 +0						
92.1414+3	811.9708+3	261.0569+3	507.9138+3	0.0 +0					
100.0000+3	737.1170+3	340.9230+3	689.5450+3	20.1031+3					
105.5500+3	720.7668+3	334.8738+3	677.2090+3	21.0017+3	0.0 +0				
168.8400+3	534.3123+3	272.7331+3	596.5337+3	31.2484+3	270.1749+3	0.0 +0			
169.5150+3	532.3237+3	272.0704+3	535.0333+3	31.3756+3	273.0564+3	3.1454+3	0.0 +0		
200.0000+3	449.5140+3	242.1390+3	467.2740+3	36.2932+3	403.1920+3	145.2020+3	165.9820+3		
210.3760+3	435.4644+3	240.6034+3	458.2378+3	37.3683+3	397.0191+3	147.5682+3	170.1520+3	0.0 +0	
300.0000+3	374.5739+3	227.3390+3	380.1660+3	46.6546+3	343.7000+3	168.0070+3	206.1710+3	168.6800+3	
308.7490+3	372.9223+3	224.4613+3	375.4862+3	46.2674+3	339.7679+3	165.4380+3	207.4256+3	170.8256+3	0.0 +0
326.0540+3	369.6555+3	218.7660+3	366.1849+3	45.5011+3	331.9858+3	160.3538+3	209.9858+3	175.0719+3	17.2753-3
347.1740+3	365.6727+3	211.8225+3	354.8451+3	44.5669+3	372.4981+3	154.1553+3	212.9358+3	180.2490+3	38.3370-3
352.3380+3	364.6984+3	210.1240+3	352.0711+3	44.3384+3	320.1772+3	152.6390+3	213.6763+3	181.5154+3	43.4891-3
400.0000+3	355.7060+3	194.4470+3	326.4680+3	42.2291+3	298.7560+3	138.6440+3	220.5110+3	193.2040+3	91.0419-3
500.0000+3	352.7420+3	193.5100+3	309.9510+3	44.5273+3	285.8570+3	133.0430+3	234.0250+3	209.1140+3	101.3750-3
600.0000+3	348.5610+3	195.0900+3	301.3703+3	45.9887+3	280.3030+3	128.7190+3	244.7380+3	221.5860+3	108.3410-3
700.0000+3	340.5390+3	195.7470+3	294.3450+3	46.2887+3	276.4060+3	124.0170+3	251.9690+3	231.0150+3	115.8850-3
800.0000+3	327.0560+3	193.3650+3	284.8280+3	45.4564+3	269.9920+3	118.3580+3	253.7330+3	235.5660+3	122.7720-3
900.0000+3	309.3040+3	187.9740+3	277.2570+3	43.8701+3	260.2980+3	112.1920+3	250.1420+3	234.9320+3	127.8420-3
1.0000+6	289.1060+3	180.3140+3	257.3920+3	41.9123+3	247.9150+3	105.7410+3	242.1930+3	229.8020+3	130.5200-3
1.2500+6	232.6450+3	153.6200+3	212.6590+3	36.2184+3	207.5840+3	89.4318+3	207.5290+3	209.6820+3	125.0510-3
1.5000+6	177.3330+3	122.7340+3	165.5440+3	30.3638+3	162.8100+3	73.5699+3	163.9900+3	160.3640+3	107.1280-3
1.7500+6	130.6490+3	93.6607+3	123.8160+3	24.8808+3	122.3120+3	59.0163+3	123.2170+3	121.2449+3	85.0067-3
2.0000+6	93.3750+3	64.5900+3	89.2972+3	19.6900+3	88.4142+3	46.0708+3	88.9866+3	87.8562+3	65.5623-3
2.5000+6	44.6606+3	33.4636+3	42.8408+3	11.2153+3	42.4934+3	25.7380+3	42.9307+3	42.4750+3	31.5715-3
3.0000+6	20.1012+3	14.9868+3	19.1179+3	5.7126+3	18.9759+3	3.0141+3	19.3791+3	19.1994+3	14.2244-3
4.0000+6	3.6644+3	2.6444+3	3.4089+3	1.2935+3	3.3869+3	2.8835+3	3.5641+3	3.5386+3	2.5421+3
6.0000+6	110.6800+6	73.2167+5	98.1041+6	39.5584+6	97.5710+6	49.6705+6	107.9350+6	107.2070+6	70.6269+6
8.0000+6									
10.0000+6									

TABLE A2 - 27

NUCLEUS ... 63-EU-153

## PARAMETERS

## CROSS SECTION(HARN) AND MU-BAR

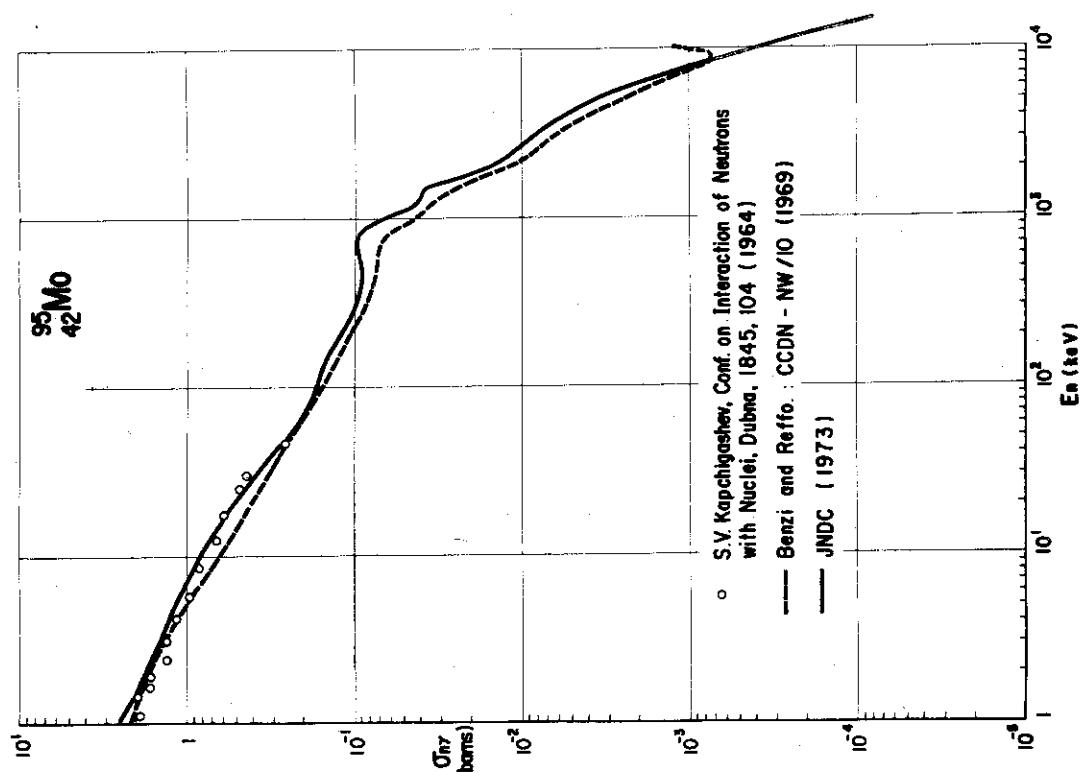
			ENERGY(EV)	TOTAL	ELASTIC	INELASTIC	CAPTURE	MU-BAR
NEUTRON SEPARATION ENERGY	6.391E 00(MEV)	ABOVE 0.1MEV	100.0000+0	176.7420+0	7.7420+0	169.0000+0	2.1500+3	
LEVEL PARAMETER(XI-ZERO)	2.643E 01	BELOW 0.1MEV	300.0000+0	103.3210+0	29.8210+0	73.5000+0	4.4306+3	
LEVEL SPACING .....	1.300E 00(MEV)	ABOVE 0.1MEV	1.0000+0	57.9108+0	25.9104+0	32.0000+0	4.4602+3	
	2.600E 00	BELOW 0.1MEV	3.0000+0	34.6198+0	20.4194+0	14.2000+0	5.4030+3	
LEVEL DENSITY PARAMETER ..	2.518E 01(1/MEV)	TAG.	10.0000+3	20.1348+0	14.6048+0	5.5200+0	9.7704+3	
	2.442E 01(1/MEV)	COM.						
PAIRING ENERGY .....	1.100E 00(MEV)	TAG.	20.0000+3	14.9244+0	11.7044+0	3.2200+0	17.8422+3	
	0.0	COM.	50.0000+3	10.2147+0	8.5247+0	1.6900+0	45.7136+3	
NORMALIZATION FACTOR .....	3.460E 03(1/MEV)	TAG.	83.9196+3	6.5598+0	7.3004+0	0.0 +0	1.7299+0	84.7345+3
TANGENCY POINT .....	4.780E 00(MEV)	TAG.	98.0723+3	7.9260+0	6.1372+0	6.361.1200+3	1.1527+0	101.0154+3
	3.474E 00(MEV)	COM.	100.0000+3	7.8342+0	5.9713+0	722.9090+3	1.1400+0	103.2330+3
ADOPTED LEVELS (MEV)								
1. GROUND	5/2+		103.8590+3	7.7777+0	5.9149+0	753.7440+3	1.1090+0	108.0413+3
2. 0.08337	7/2+		152.6200+3	7.0639+0	5.0705+0	1.1555+0	837.8279+3	168.7845+3
3. 0.09743	5/2-		173.9940+3	6.7505+0	6.6950+0	1.3390+0	761.4875+3	195.4288+3
4. 0.10318	3/2+		192.6620+3	6.4778+0	4.2678+0	1.5027+0	706.9940+3	216.6889+3
5. 0.15161	7/2-		200.0000+3	6.3700+0	4.1140+0	1.5674+0	688.0000+3	227.8320+3
6. 0.17285	5/2+		269.7670+3	6.1220+0	3.8990+0	1.6499+0	573.0164+3	276.1701+3
7. 0.1914	9/2+		300.0000+3	6.0145+0	3.7914+0	1.6861+0	537.0000+3	297.1170+3
8. 0.268	7/2+		400.0000+3	5.0269+0	3.7779+0	1.7390+0	510.0000+3	336.0040+3
9. 0.6346	1/2-		500.0000+3	5.1871+0	3.8720+0	1.8061+0	509.0000+3	364.3640+3
10. 0.6364	3/2+		600.0000+3	5.3988+0	4.0070+0	1.8764+0	515.0000+3	390.9080+3
11. 0.682	5/2-		638.7840+3	5.4815+0	4.0630+0	1.9030+0	515.4061+3	401.7563+3
12. 0.6943	1/2-		640.5950+3	5.6154+0	4.0575+0	1.9043+0	515.4245+3	402.2631+3
13. 0.7064	3/2+		686.4960+3	5.5837+0	4.1320+0	1.9359+0	515.8735+3	415.1018+3
			698.8770+3	5.6103+0	4.1494+0	1.9444+0	515.9896+3	418.5649+3
			700.0000+3	5.6127+0	4.1515+0	1.9452+0	516.0000+3	418.8790+3
			711.0570+3	6.6341+0	4.1662+0	1.9534+0	516.5769+3	422.7529+3
			714.6810+3	6.6411+0	4.1711+0	1.9561+0	516.1162+3	423.3588+3
			800.0000+3	6.8066+0	4.2831+0	2.0195+0	504.0000+3	449.3930+3
			900.0000+3	6.9704+0	4.4025+0	2.0768+0	491.0000+3	480.3490+3
			1.0000+6	7.1017+0	4.5093+0	2.1155+0	477.0000+3	510.2470+3
			1.2500+6	7.2983+0	4.7097+0	2.2026+0	386.0000+3	576.6320+3
			1.5000+6	7.3983+0	4.8007+0	2.2386+0	309.0000+3	626.4720+3
			1.7500+6	7.4981+0	4.8056+0	2.2571+0	240.0000+3	666.3360+3
			2.0000+6	7.1815+0	4.7332+0	2.2623+0	185.0000+3	692.5940+3
			2.5000+6	6.8359+0	4.4559+0	2.2700+0	110.0000+3	721.6860+3
			3.0000+6	6.4282+0	4.0797+0	2.2835+0	65.6000+3	732.6030+3
			4.0000+6	5.6247+0	5.3137+0	2.2903+0	20.7000+3	732.2670+3
			6.0000+6	7.1166+0	7.4242+0	2.2942+0	1.6800+0	661.8000+3
			8.0000+6	4.6252+0	2.3678+0	2.2571+0	170.0000+3	729.4444+3
			10.0000+6	4.8244+0	2.6293+0	2.1949+0	20.0000+6	796.2070+3
			11.0000+6	4.9809+0	2.7742+0	2.2067+0	10.0000+6	823.6570+3
			12.0000+6	5.1476+0	2.9039+0	2.2436+0		846.5390+3
			15.0000+6	5.3830+0	3.1154+0	2.2676+0		887.9390+3

## CROSS SECTION FOR EXCITATION OF LEVELS

ENERGY(EV)	1-ST	2-ND	3-TH	4-TH	5-TH	6-TH	7-TH	8-TH	9-TH
83.9166+3	0.0 +0								
98.0723+3	512.0941+3	0.0 +0							
100.0000+3	581.8450+3	141.0640+3							
103.8590+3	577.5802+3	143.1019+3	0.0 +0						
152.6100+3	523.7020+3	168.8473+3	159.3113+3	0.0 +0					
173.9940+3	500.0611+3	180.1410+3	229.1911+3	57.4552+3	0.0 +0				
192.6620+3	479.4373+3	189.9988+3	290.1955+3	107.6130+3	275.5773+3	0.0 +0			
200.0000+3	471.3280+3	193.8740+3	314.1750+3	127.3290+3	383.9010+3	77.3274+3			
269.7670+3	392.0260+3	195.9956+3	261.8328+3	143.0580+3	389.3142+3	137.7940+3	0.0 +0		
300.0000+3	357.6610+3	196.9150+3	282.1510+3	149.8760+3	391.6660+3	156.8300+3	151.0300+3		
400.0000+3	348.2160+3	192.3050+3	275.8740+3	195.3580+3	355.7890+3	207.4260+3	204.0750+3		
500.0000+3	345.7250+3	187.4180+3	278.0820+3	186.8770+3	344.0820+3	245.5660+3	226.3570+3		
600.0000+3	384.0670+3	182.1970+3	282.4120+3	167.7870+3	346.6380+3	213.7450+3	248.5480+3		
638.7840+3	388.5020+3	173.6017+3	241.7224+3	159.0273+3	345.2569+3	261.8334+3	256.8040+3	0.0 +0	
640.5960+3	388.7096+3	173.2004+3	281.6902+3	157.8986+3	345.2850+3	262.2113+3	257.1897+3	220.0780+6	0.0 +0
686.4960+3	393.9587+3	163.0340+3	280.8741+3	154.6328+3	346.0231+3	291.7437+3	266.9604+3	5.7949+3	16.2945+3
698.8770+3	395.3748+3	166.2917+3	280.6540+3	153.7519+3	346.2220+3	294.3583+3	269.5980+3	7.2986+3	20.6897+3
700.0000+3	395.5030+3	160.0430+3	280.6340+3	153.6717+3	346.2400+3	294.6000+3	269.8330+3	7.4350+3	21.0884+3
711.0570+3	394.6378+3	157.7478+3	276.3843+3	152.2214+3	345.2664+3	294.8478+3	270.9456+3	7.7660+3	21.7227+3
714.6810+3	394.3516+3	157.0407+3	278.9748+3	151.7460+3	344.9473+3	294.9224+3	271.3093+3	7.8745+3	21.9306+3
800.0000+3	387.6610+3	139.5030+3	264.3320+3	140.5530+3	337.4350+3	296.7900+3	270.8790+3	10.4244+3	24.6233+3
900.0000+3	366.3180+3	124.9800+3	254.1680+3	126.7630+3	321.5470+3	205.1770+3	278.8850+3	13.2996+3	31.2819+3
1.0000+6	326.7650+3	110.8770+3	236.8160+3	112.7740+3	301.3800+3	267.1550+3	270.1480+3	15.2562+3	33.7226+3
1.2500+6	261.8740+3	101.9990+3	184.3310+3	82.2511+3	241.3800+3	220.2900+3	227.2190+3	16.9922+3	34.2479+3
1.5000+6	182.3740+3	57.0474+3	136.9260+3	57.5101+3	173.1320+3	147.4320+3	166.1490+3	15.0456+3	29.1120+3
1.7500+6	118.0390+3	39.0144+3	90.6050+3	39.0763+3	114.0460+3	95.8757+3	110.4510+3	11.7293+3	22.1549+3
2.0000+6	74.0891+3	26.3539+3	57.5508+3	26.3587+3	72.0767+3	60.6571+3	70.3023+3	8.5393+3	15.9025+3
2.5000+6	27.8853+3	11.5262+3	21.5979+3	11.6267+3	26.9695+3	23.3927+3	26.7435+3	4.0000+3	7.3515+3
3.0000+6	10.3110+3	4.8664+3	7.8342+3	4.9880+3	9.8715+3	8.9059+3	9.9285+3	1.7260+3	3.1636+3
4.0000+6	1.3483+3	804.8170+6	94.0051+6	856.1410+6	1.2556+3	1.2261+3	1.3146+3	290.5910+6	535.7660+6
6.0000+6	21.2375+6	17.4633+6	14.4474+6	19.7413+6	19.0409+6	20.6217+6	20.8183+6	6.3932+6	11.9795+6
8.0000+6	533.7711+9	448.5260+9	345.1480+9	517.3870+9	465.6481+9	540.8189+9	525.7882+9	166.7520+9	315.4580+9
10.0000+6									
11.0000+6									
12.0000+6									
15.0000+6									

TABLE A2 - 28  
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NUCLEUS ... 63-EU-155

PARAMETERS		CROSS SECTION(BARN) AND MU-BAR							
		ENERGY(EV)	TOTAL	ELASTIC	INFLASTIC	CAPTURE	MU-BAR		
NEUTRON SEPARATION ENERGY	6.331E 00(MEV)								
LEVEL PARAMETER(X1-ZERO)	4.775E 01								
LEVEL SPACING .....	2.500E 00(MEV)	100.0000+0	173.8200+0	152.5200+0	21.3000+0	2.5588+3			
LEVEL DENSITY PARAMETER ..	2.426E 01(1/MEV)	380.0000+0	101.6620+0	89.4620+0	12.2000+0	4.3750+3			
PAIRING ENERGY .....	2.377E 01(1/MEV) TAG.	1.0000+3	57.0264+0	50.3564+0	6.6700+0	4.5526+3			
PAIRING ENERGY .....	9.200E-01(MEV) TAG.	3.0000+3	34.1338+0	30.0538+0	4.0800+0	5.3788+3			
PAIRING ENERGY .....	0.0 (MEV) COM.	10.0000+3	19.8973+0	17.0973+0	2.8000+0	9.8789+3			
NORMALIZATION FACTOR .....	3.377E 03(1/MEV) TAG.	20.0000+3	14.7767+0	12.3267+0	2.4500+0	16.1823+3			
TANGENCY PCINT .....	4.388E 00(MEV) TAG.	50.0000+3	10.1447+0	8.1447+0	2.0000+0	46.7809+3			
TANGENCY PCINT .....	3.462E 00(MEV) COM.	75.4881+3	8.9575+0	7.3190+0	0.0	1.6385+0	76.1968+3		
ADOPTED LEVELS (MEV)		100.0000+3	7.8118+0	9.7816+0	600.2590+3	1.4300+0	104.4860+3		
		105.0290+3	7.7400+0	5.7613+0	617.2640+3	1.3614+0	109.2469+3		
1. GROUND	5/2+	171.1060+3	5.7955+0	826.9550+3	834.8334+3	171.8006+3			
2. 0.075	7/2+	200.0000+3	6.3826+0	4.6933+0	975.2970+3	714.0000+3	199.1540+3		
3. 0.10435	5/2-	247.8020+3	6.2212+0	4.4891+0	1.1339+0	598.2882+3	232.9983+3		
4. 0.117	7/2-	300.0000+3	6.0450+0	4.2185+0	1.3155+0	511.0000+3	269.9550+3		
5. 0.2462	3/2+	312.0170+3	6.0479+0	4.2037+0	1.3464+0	495.7006+3	275.0421+3		
6. 0.31	5/2+	400.0000+3	6.0687+0	4.0625+0	1.5972+0	409.0000+3	319.7770+3		
7. 0.76	1/2-	500.0000+3	6.2363+0	4.1680+0	1.6930+0	378.0000+3	346.9400+3		
8. 0.87	5/2+	600.0000+3	6.4524+0	4.3127+0	1.7616+0	378.0000+3	371.8740+3		
9. 1.09	3/2+	700.0000+3	6.6695+0	4.4627+0	1.8144+0	392.0000+3	397.9470+3		
10. 1.27	5/2-	764.0460+3	6.7964+0	4.5524+0	1.8394+0	405.8309+3	415.6786+3		
		800.0000+3	6.8649+0	4.6039+0	1.8480+0	413.0000+3	425.2490+3		
		875.6620+3	6.9890+0	4.8665+0	1.8742+0	428.2601+3	447.6298+3		
		900.0000+3	7.0289+0	4.7133+0	1.8826+0	431.0000+3	454.8290+3		
		1.3000+6	7.1598+0	4.8168+0	1.8929+0	450.0000+3	482.7170+3		
		1.0971+6	7.2346+0	4.8879+0	1.8762+0	470.5154+3	506.5312+3		
		1.2500+6	7.3526+0	5.0018+0	1.8897+0	501.0000+3	544.0370+3		
		1.2783+6	7.3575+0	5.0142+0	1.8601+0	483.1996+3	549.8938+3		
		1.4594+6	7.3895+0	5.0748+0	1.9268+0	349.9479+3	587.4470+3		
		1.5000+6	7.3967+0	5.0819+0	1.9448+0	375.0000+3	395.8490+3		
		1.7500+6	7.3405+0	5.0511+0	2.3130+0	11.3000+3	727.1450+3		
		6.0000+6	4.7365+0	2.4264+0	2.3092+0	950.0000+6	691.4080+3		
		8.0000+6	4.6633+0	2.3942+0	2.2690+0	110.0000+6	732.2690+3		
		10.0000+6	4.8755+0	2.6662+0	2.2093+0	20.0000+6	739.3480+3		
		11.0000+6	5.0359+0	2.8122+0	2.2237+0	10.0000+6	826.6700+3		
		12.0000+6	5.2033+0	2.9412+0	2.2621+0		848.9350+3		
		15.0000+6	5.4188+0	3.1402+0	2.2788+0		889.1510+3		
CROSS SECTION FOR EXCITATION OF LEVELS									
ENERGY(EV)	1-ST	2-ND	3-TH	4-TH	5-TH	6-TH	7-TH	8-TH	9-TH
75.4881+3	0.0 +0								
100.0000+3	600.2590+3								
105.0290+3	601.3089+3	0.0 +0							
171.1060+3	615.1031+3	14.3.2204+3	0.0 +0						
200.0000+3	621.1390+3	234.5930+3	119.5670+3						
247.8020+3	625.5806+3	243.5463+3	162.5007+3	0.0 +0					
300.0000+3	630.4330+3	253.3210+3	188.4630+3	243.2950+3					
312.0170+3	627.0618+3	251.9366+3	191.0394+3	242.1194+3	0.0 +0				
400.0000+3	602.3640+3	241.9700+3	204.9030+3	233.5170+3	309.6550+3				
500.0000+3	645.1500+3	238.6190+3	221.6780+3	249.5A10+3	335.3050+3				
600.0000+3	677.0070+3	233.1870+3	225.7700+3	269.7A40+3	356.3680+3				
700.0000+3	682.8100+3	226.1700+3	225.6210+3	268.9210+3	361.3190+3				
764.9460+3	693.6134+3	219.5760+3	223.3492+3	298.6869+3	346.9281+3	0.0 +0			
800.0000+3	694.0470+3	216.0170+3	222.1230+3	303.9580+3	405.3530+3	6.4941+3			
875.6620+3	676.9141+3	207.3507+3	217.9064+3	304.1R45+3	410.0327+3	11.1430+3	0.0 +0		
900.0000+3	671.4030+3	204.5630+3	216.5500+3	304.2600+3	411.5380+3	12.6394+3	61.6375+1		
1.0000+6	647.7090+3	194.7110+3	211.5530+3	303.2400+3	417.0060+3	17.1280+3	161.4390+1		
1.0971+6	618.9319+3	186.5531+3	207.0562+3	293.4001+3	411.2975+3	20.4409+3	119.4444+3	0.0 +0	
1.2500+6	573.6100+3	173.6490+3	199.9700+3	277.9200+3	402.3070+3	25.4627+3	147.4030+1	48.7576+3	
1.2783+6	563.1530+3	171.5786+3	197.6952+3	274.9640+3	397.8941+3	26.0436+3	152.8689+1	51.9151+3	0.0 +0
1.4994+6	496.1113+3	158.0162+3	183.0866+3	259.9742+3	369.6025+3	29.7677+3	185.3472+3	72.1544+3	26.7084+3
1.5000+6	491.1030+3	154.9400+3	174.8150+3	251.7230+3	363.2690+3	30.6014+3	192.6180+1	16.6902+3	30.2398+3
1.7500+6	232.5030+3	91.7932+3	96.3378+3	150.5300+3	199.7770+3	23.7953+3	135.2610+3	71.6621+3	30.9100+3
2.0000+6	166.2170+3	47.6884+3	48.2705+3	75.7717+3	96.7467+3	14.4203+3	74.6310+3	46.9735+3	21.9074+3
2.5000+6	25.9620+3	13.8558+3	13.9426+3	19.3717+3	24.2254+3	4.7212+3	20.7490+3	14.9822+3	8.4794+3
3.0000+6	8.1160+3	4.9362+3	5.0501+3	6.0143+3	7.5357+3	1.7300+3	6.6260+1	4.9335+3	3.3312+3
4.0000+6	1.0273+3	756.5100+6	805.4971+6	724.1040+6	927.8921+6	271.0250+6	836.6330+6	642.2740+6	561.3620+6
6.0000+6	20.3433+6	17.8475+6	20.2378+6	13.3327+6	17.6458+6	6.5425+6	16.7022+6	11.8002+6	15.5023+6
10.0000+6									
11.0000+6									
12.0000+6									
15.0000+6									



### Appendix 3. Graphical Display of the Gross Sections.

The cross sections obtained in this work are shown in Figs. A.3(a)-1 to A.3(c)-28. The neutron capture cross sections of Mo-95, Mo-97, Tc-99, Ru-102, Ru-104, Rh-103, Ag-109, Cs-133, Sm-147, Sm-149 and Eu-153 are compared with the experimental data<sup>29,124-160</sup> in Figs. A.3(a)-1 through A.3(a)-11. In Figs. A.3(b)-1 to A.3(b)-28, the capture cross sections obtained in this work are shown with the evaluated cross-section curves of ENDF/B-3<sup>6</sup>, URNDL and Benzi et al.<sup>2-4</sup> Symbols B, E, J and U in Figs. A.3(b)-1 through A.3(b)-28 stand for Benzi et al., ENDF/B-3, JNDC and URNDL, respectively. The curves in the original figures could be identified by different colours, which had been provided by the program SPINT. 123) Because of technical limitation in printing, the coloured figures could not be illustrated in this report. The authors would apologize to the readers who might find difficulties in identifying the curves.

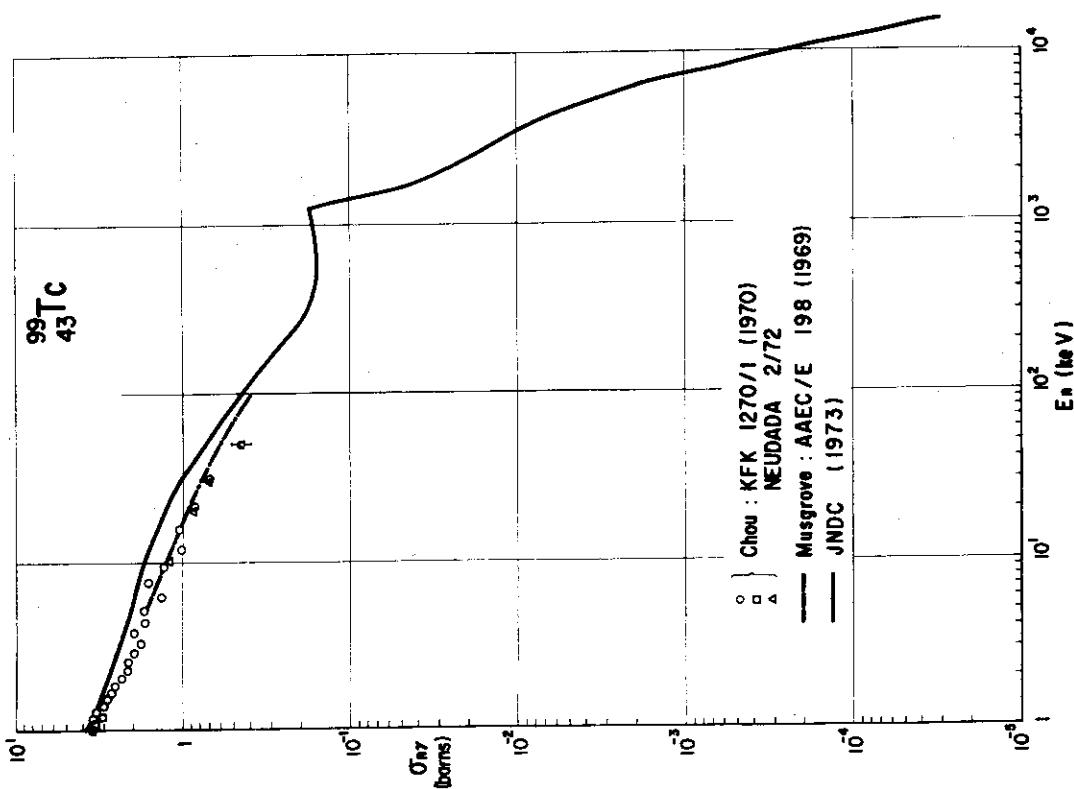


Fig A · 3(a)-3

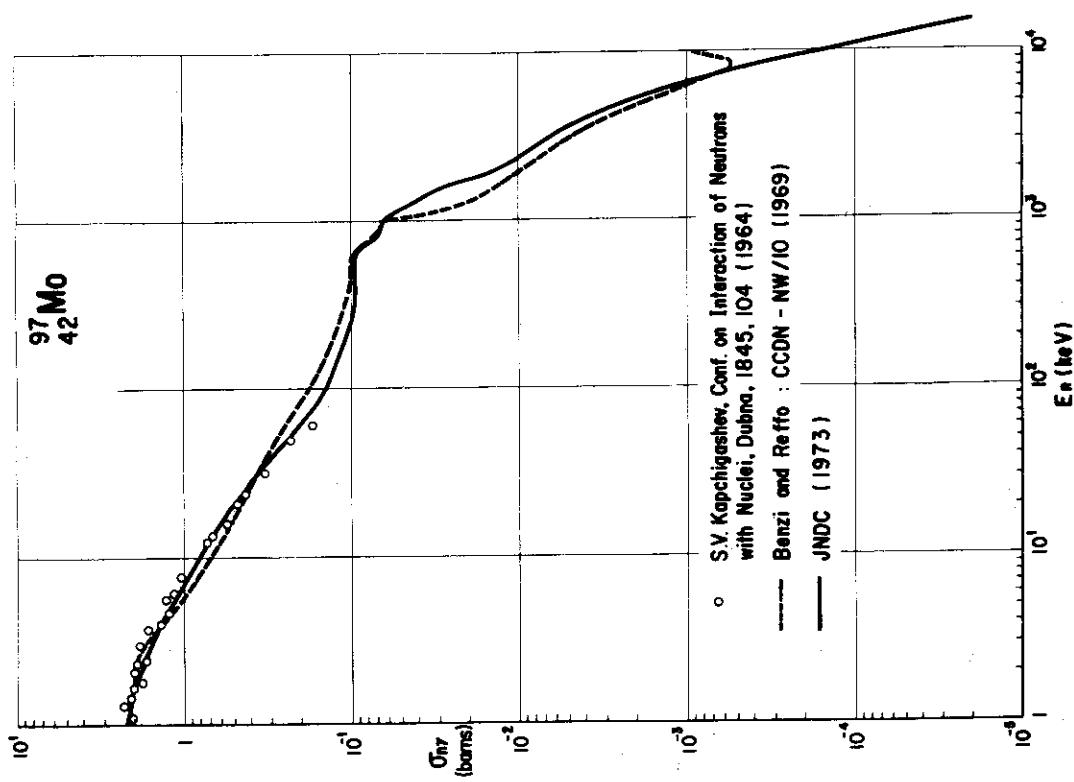


Fig A · 3(a)-2

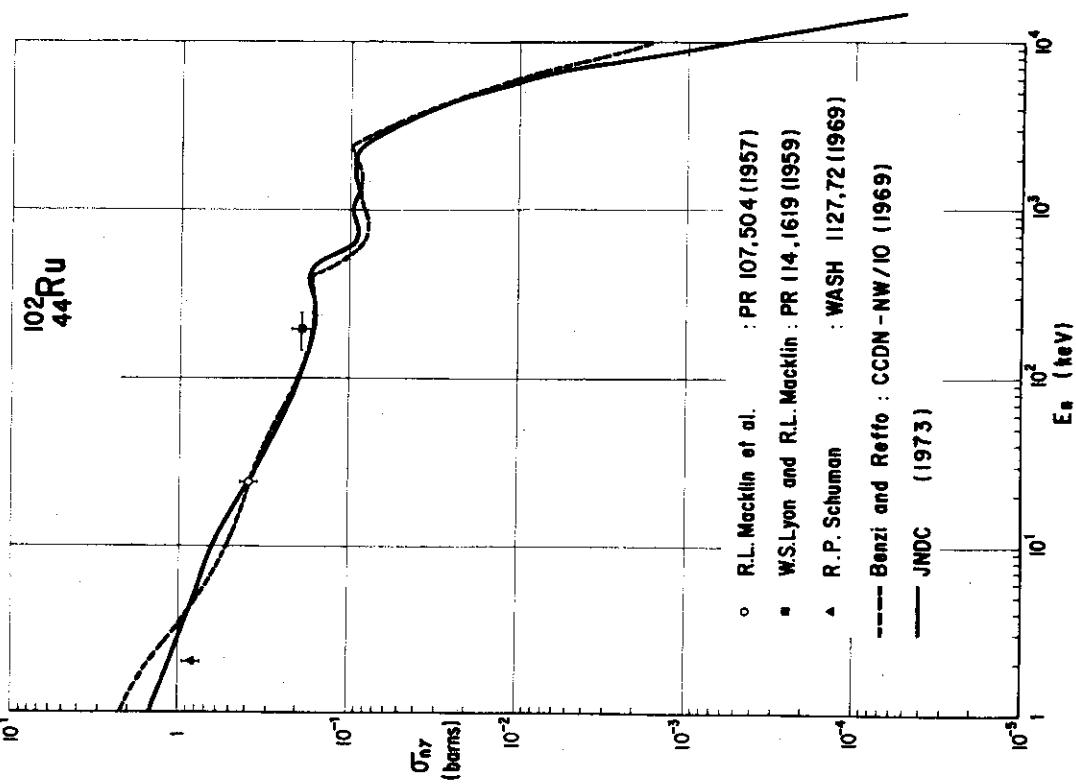


Fig. A. 3(a)-4

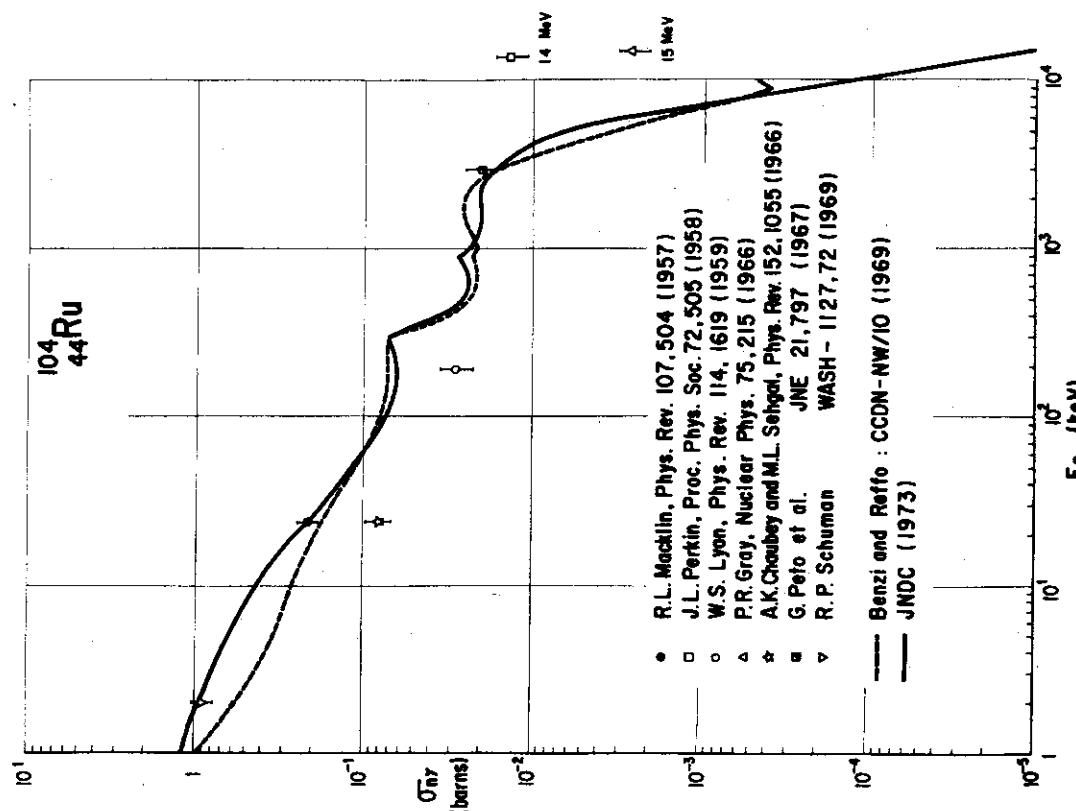


Fig. A. 3(a)-5

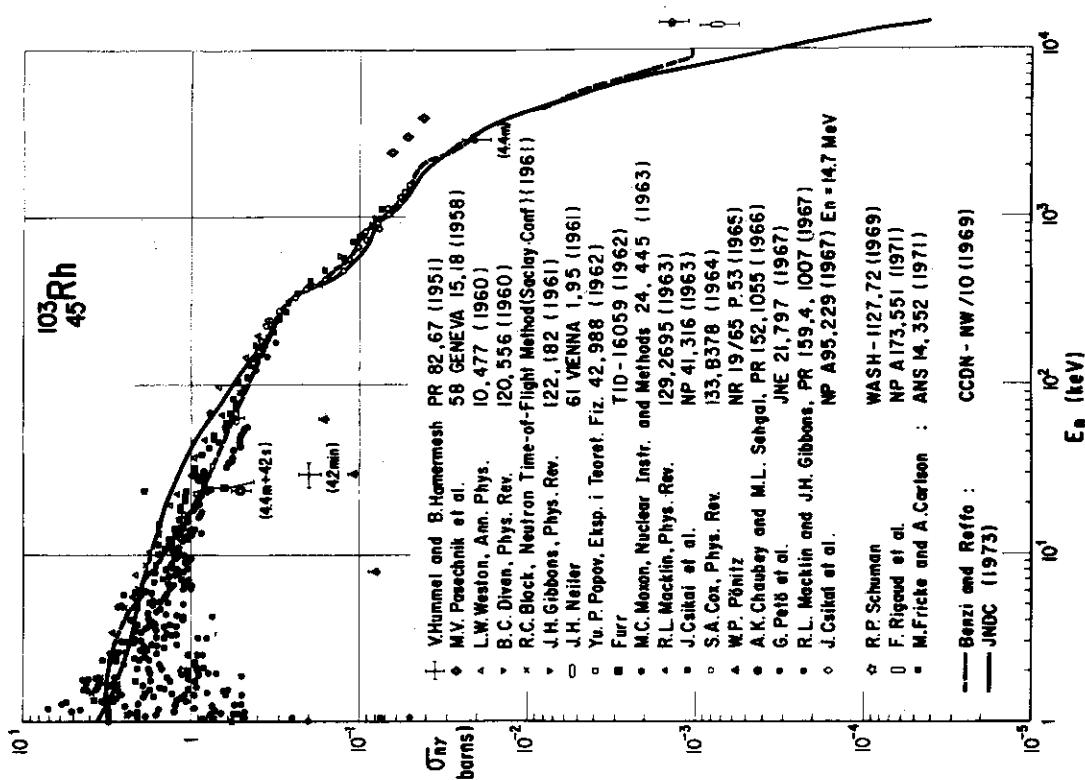


Fig A • 3(a)–6

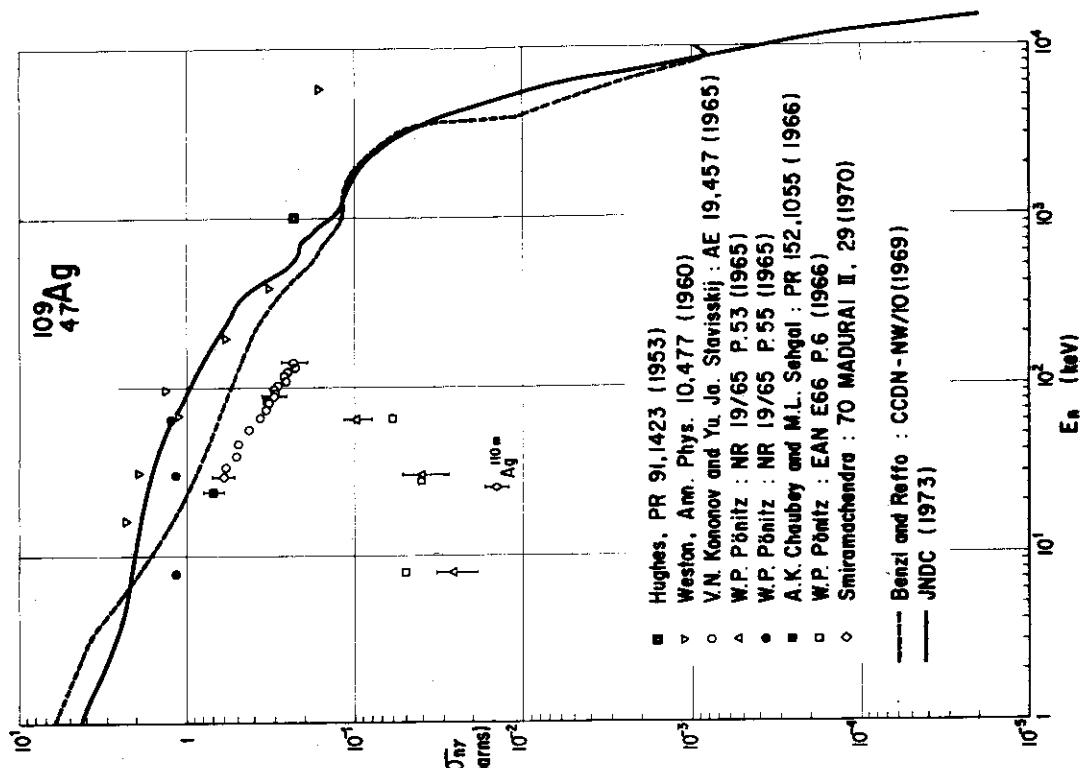


Fig A • 3(a)–7

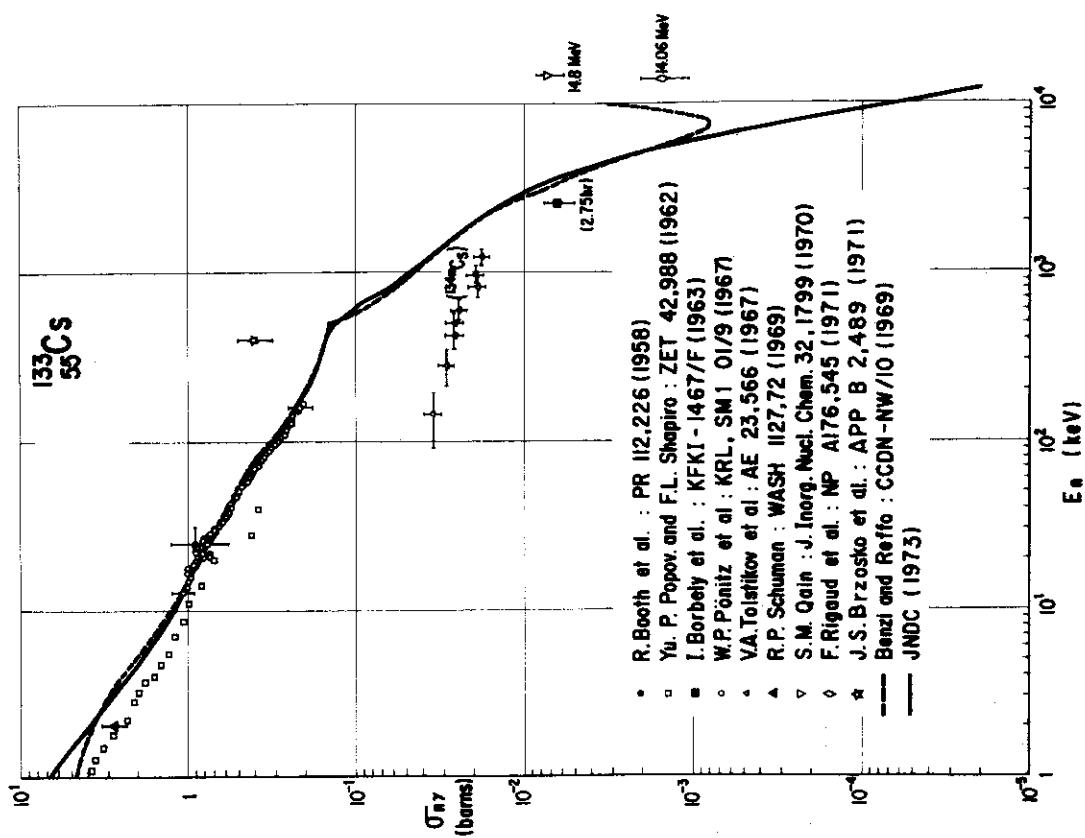


Fig A · 3(a) — 8

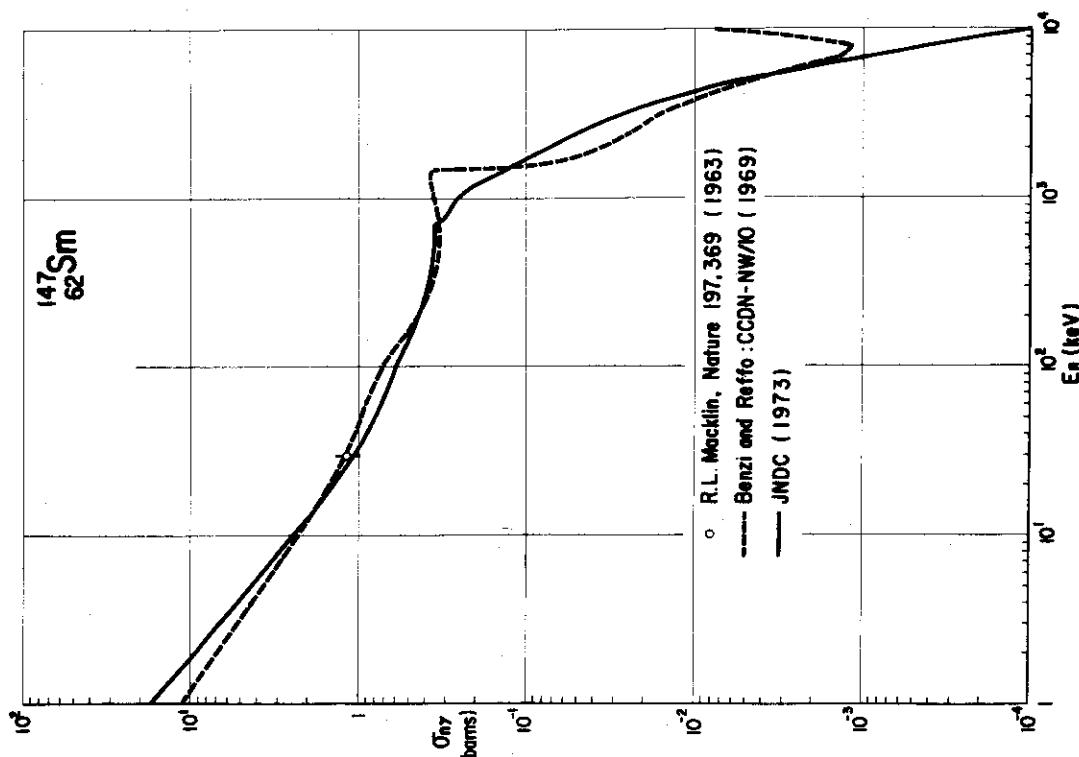


Fig A · 3(a) — 9

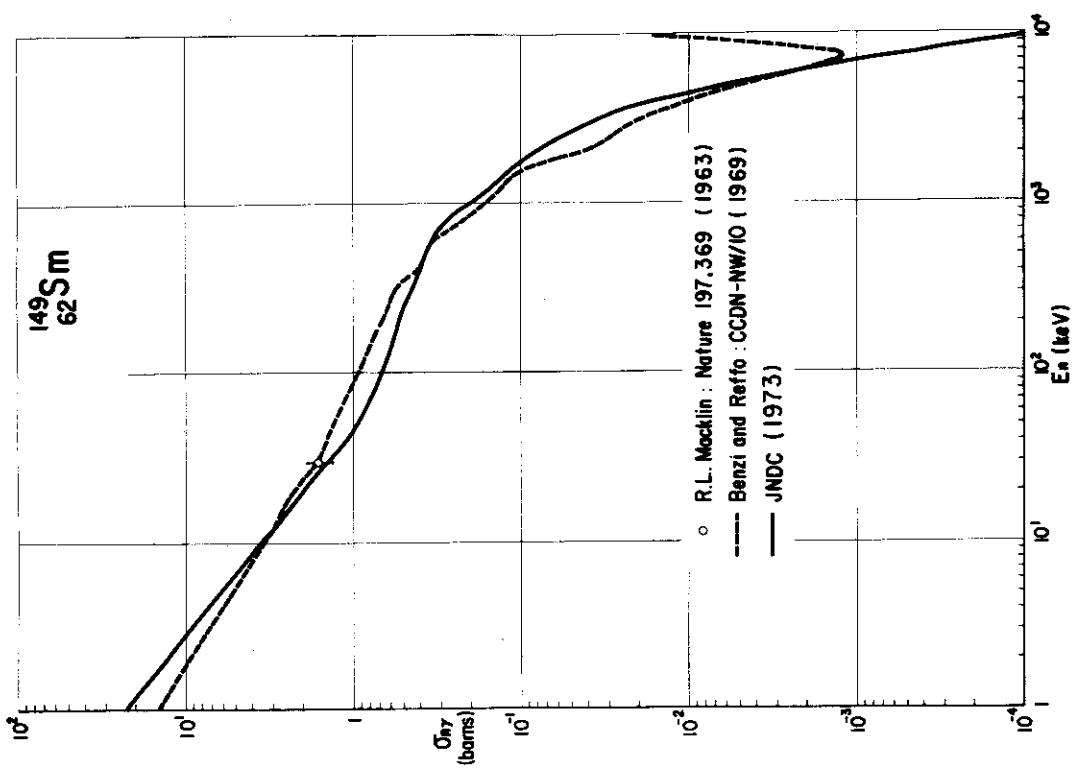


Fig A · 3(a)-10

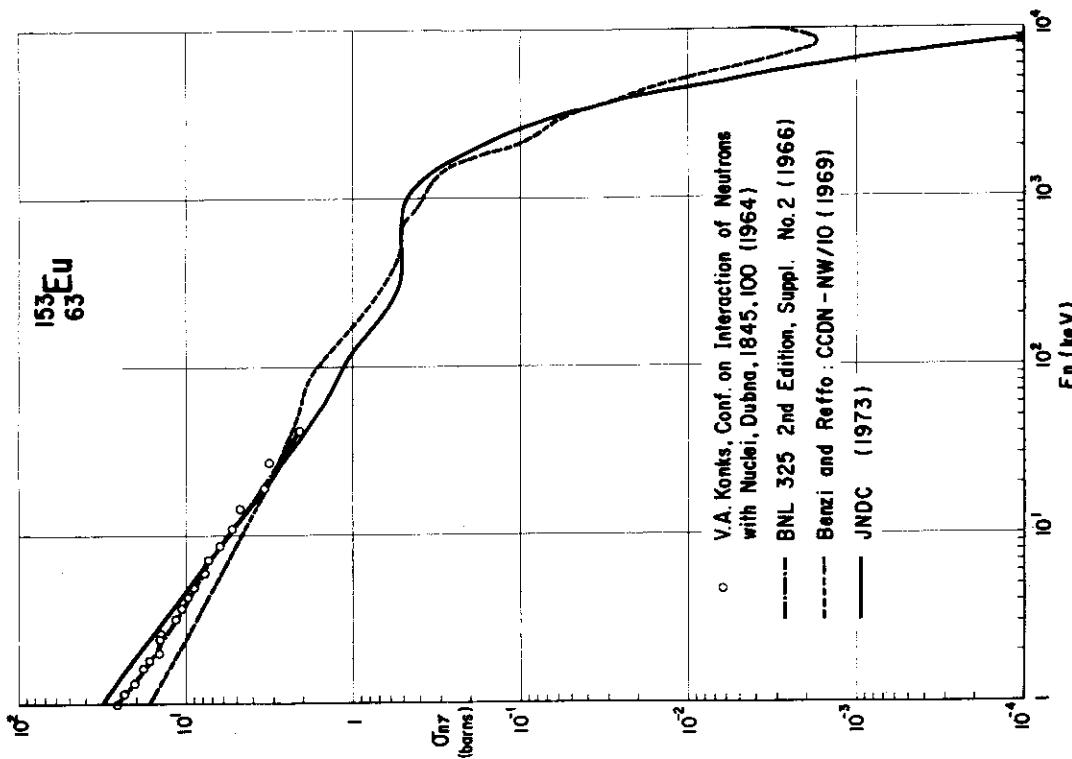


Fig A · 3(a)-11

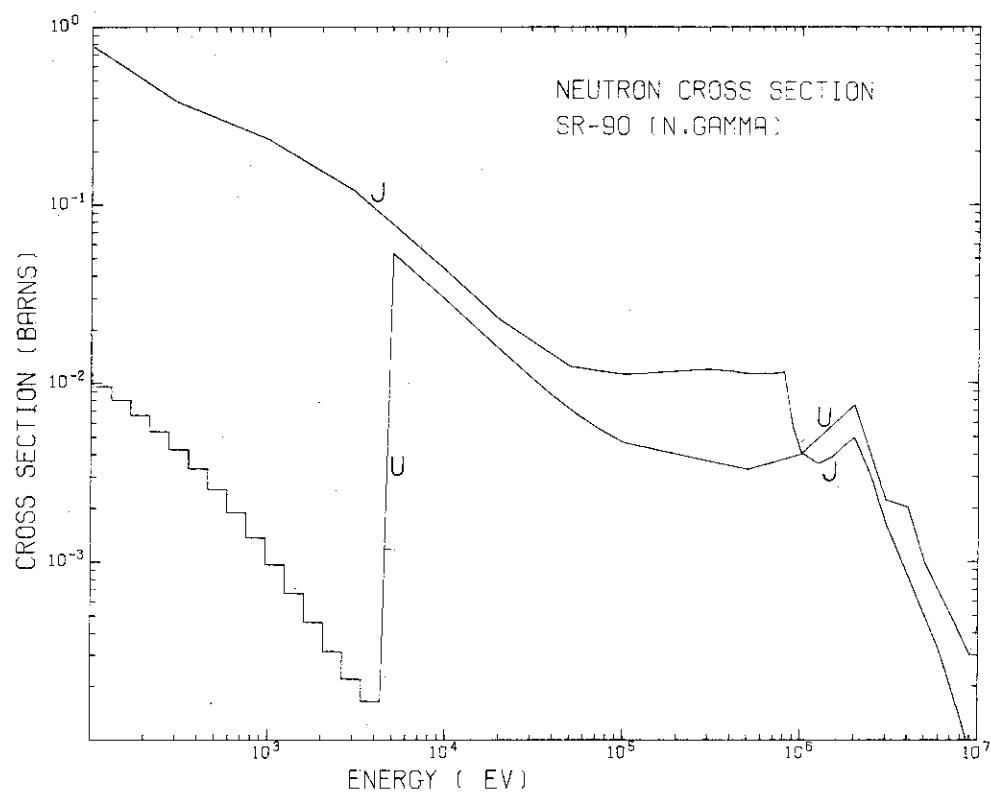


Fig A · 3(b)-1

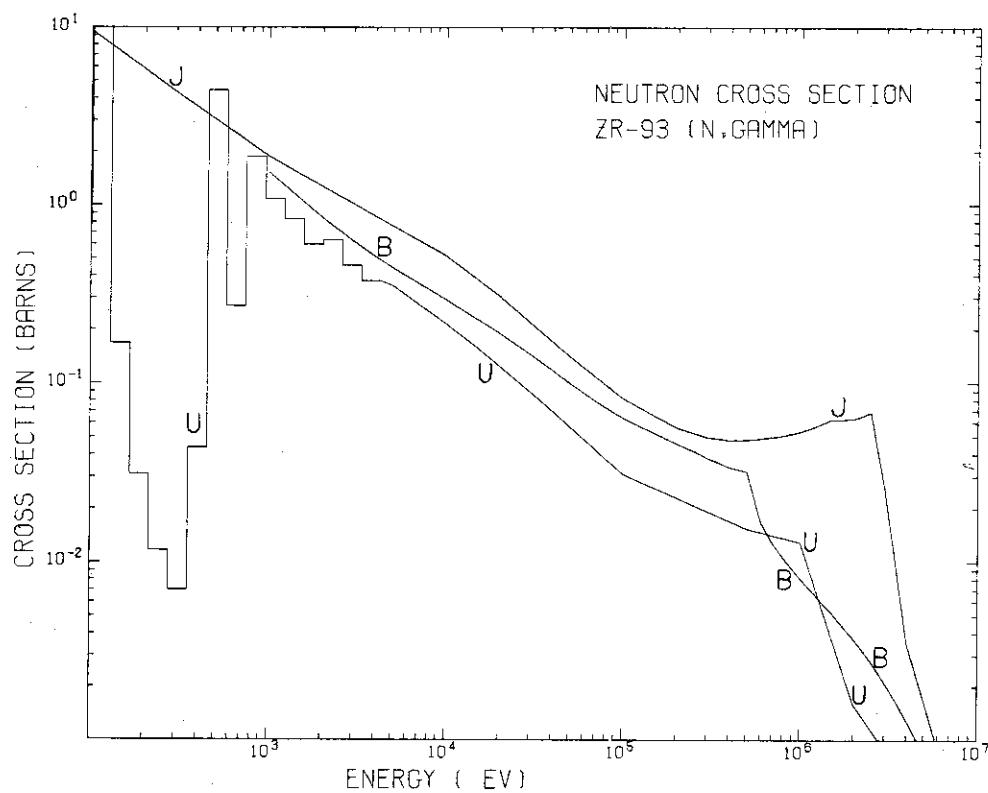


Fig A · 3(b)-2

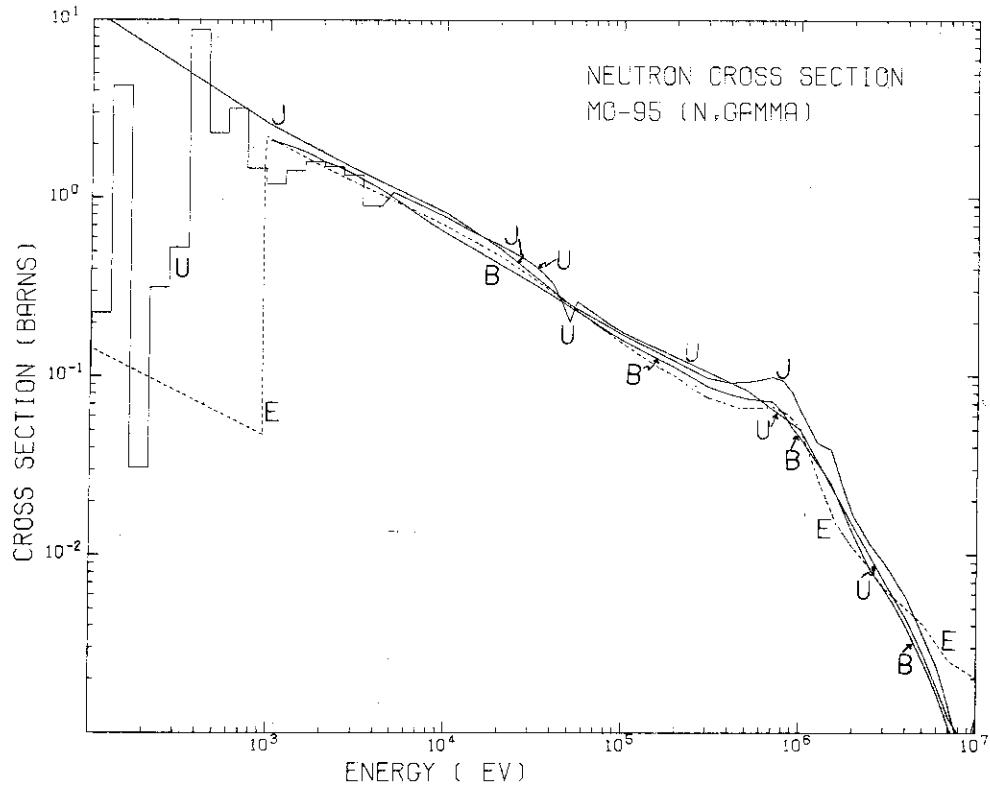


Fig A · 3(b)-3

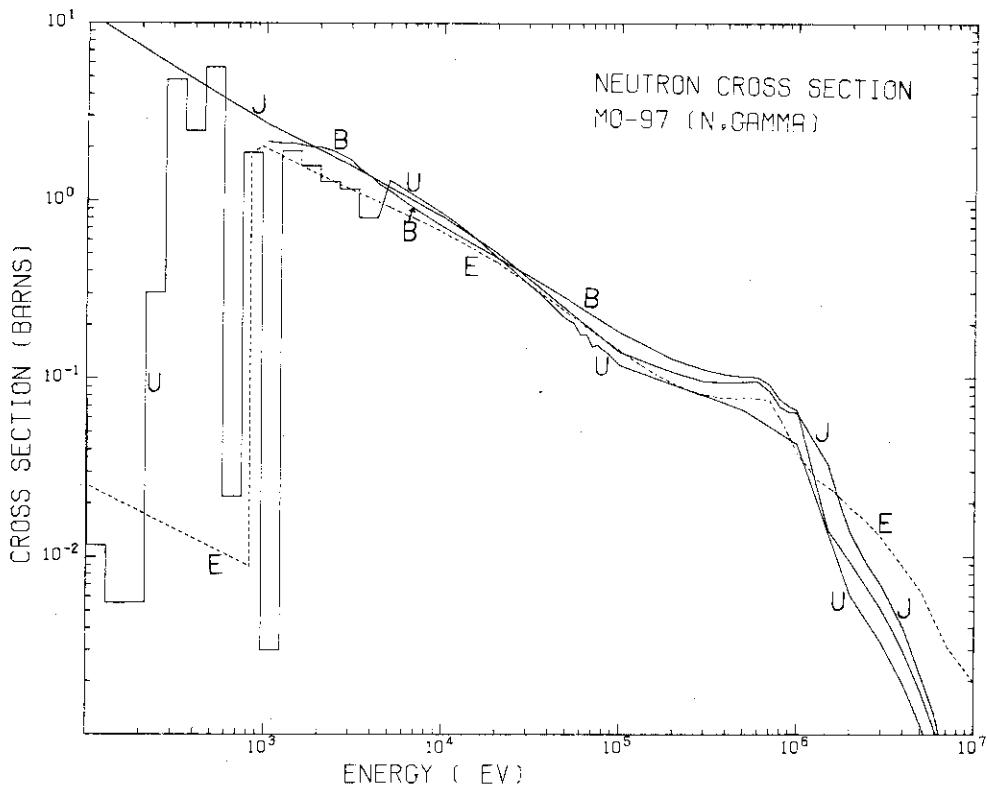


Fig A · 3(b)-4

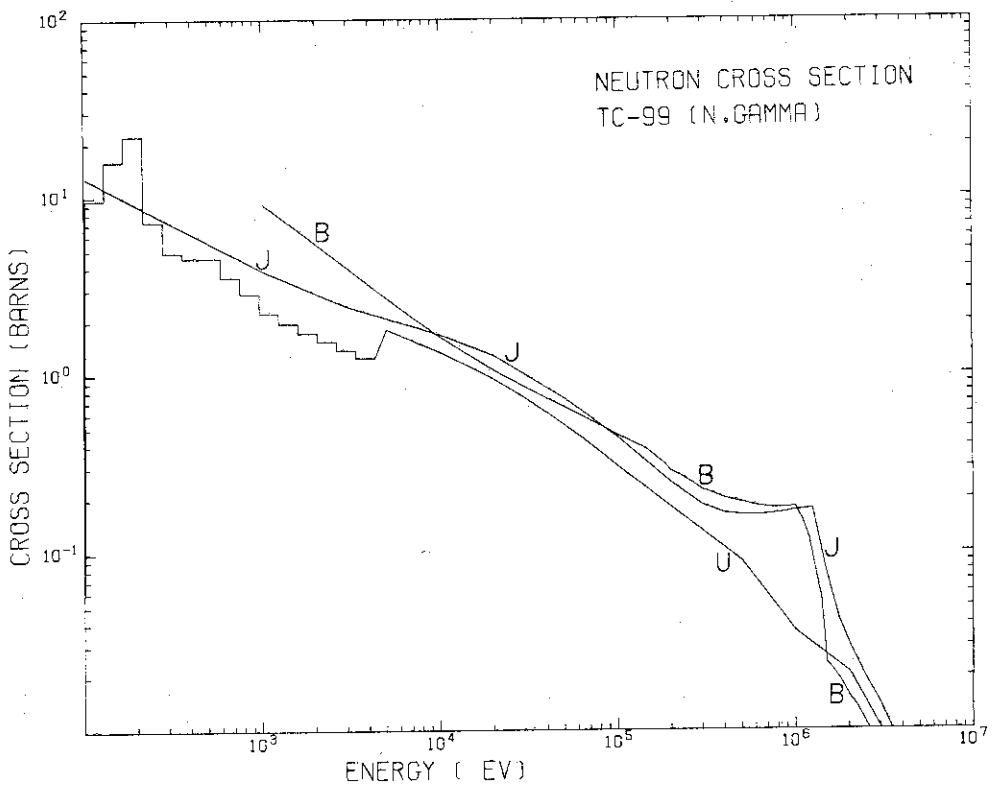


Fig A-3(b)-5

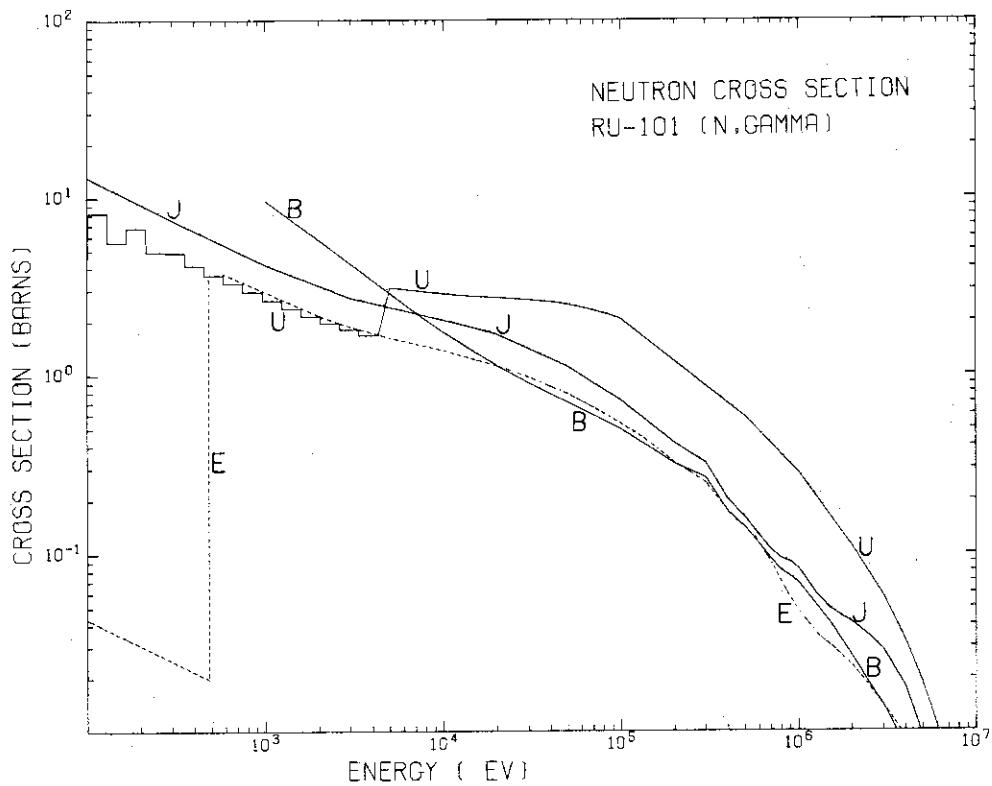


Fig A-3(b)-6

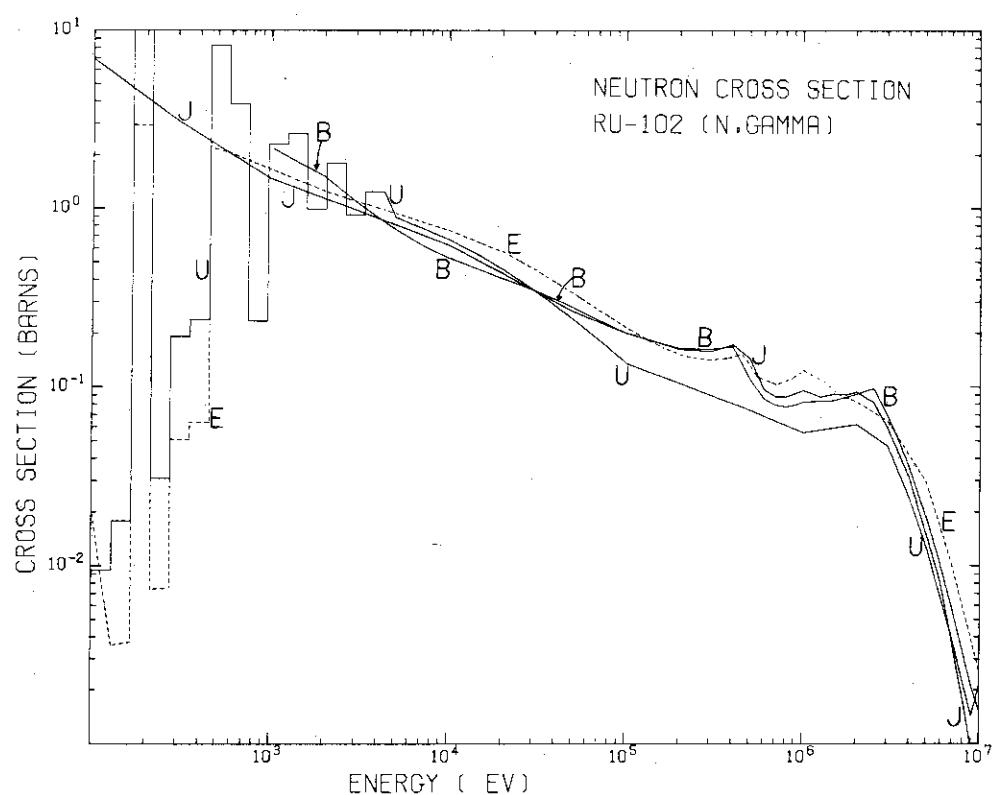


Fig A · 3(b) - 7

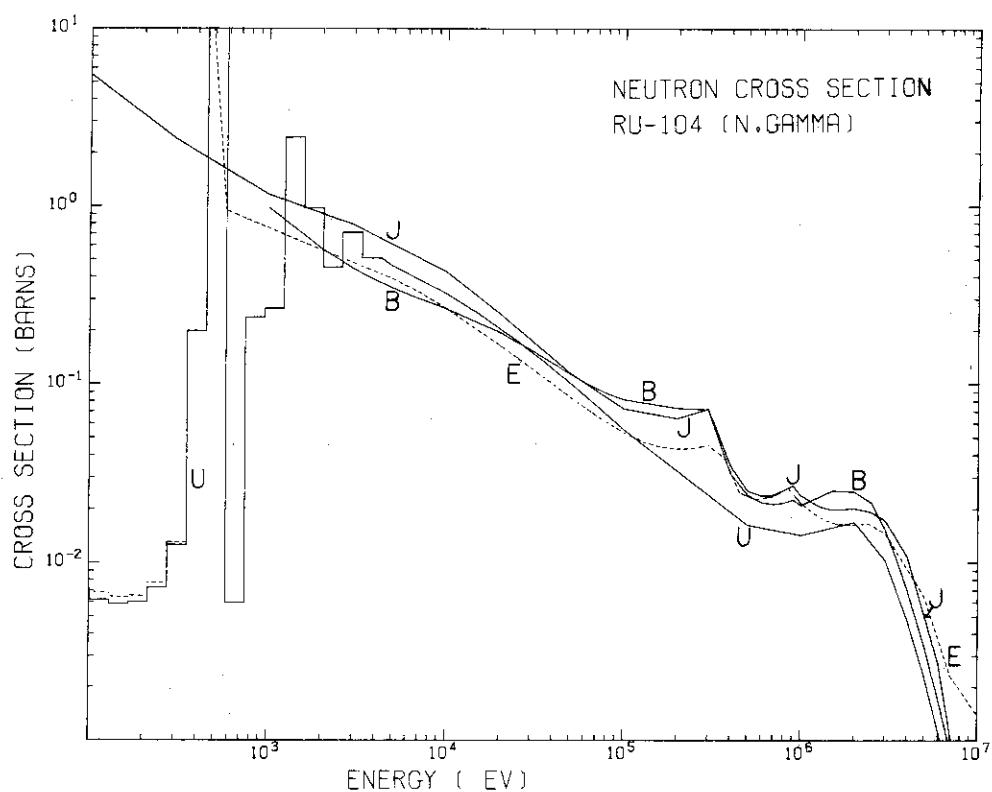


Fig A · 3(b) - 8

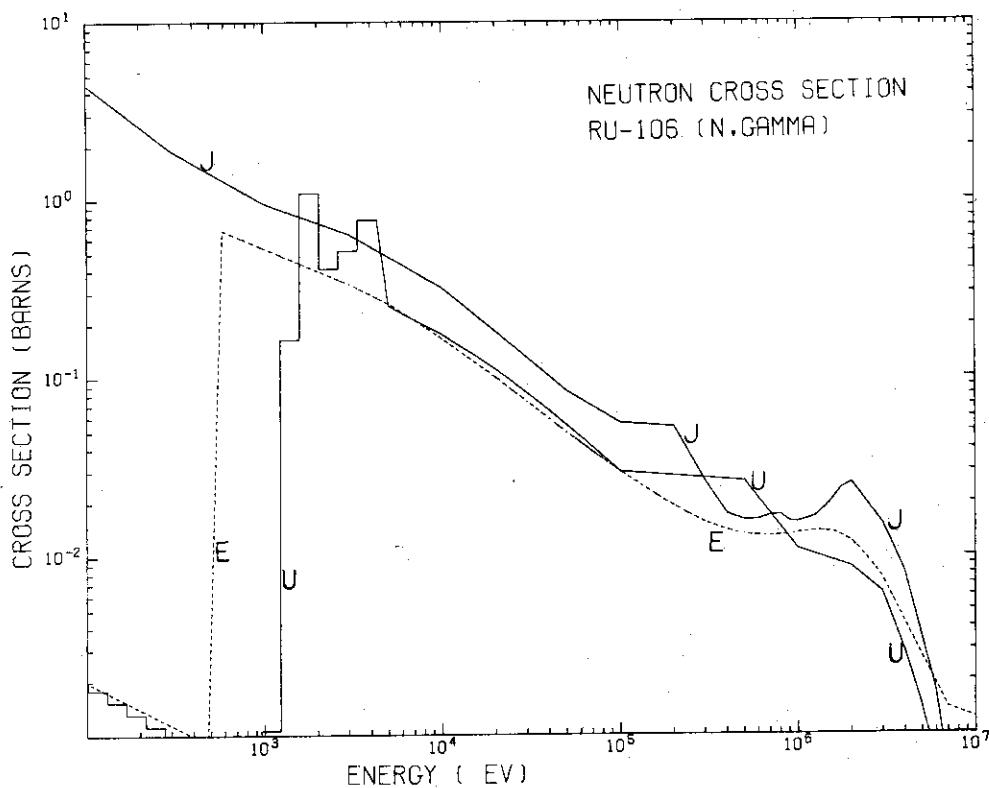


Fig A · 3(b)-9

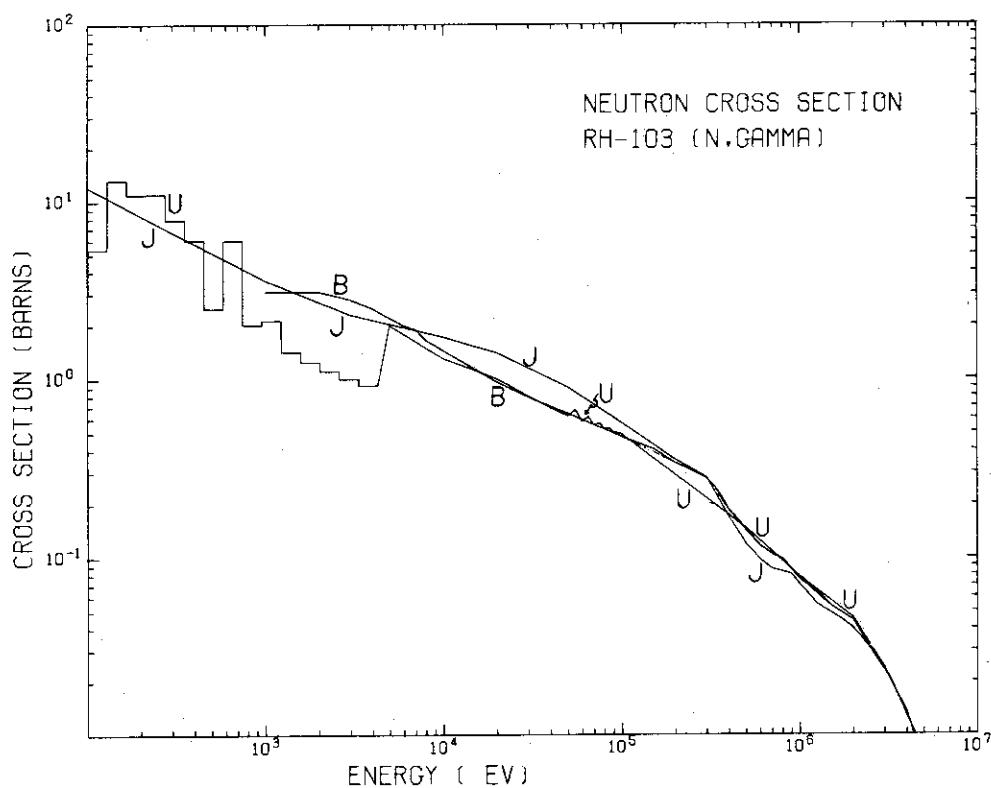


Fig A · 3(b)-10

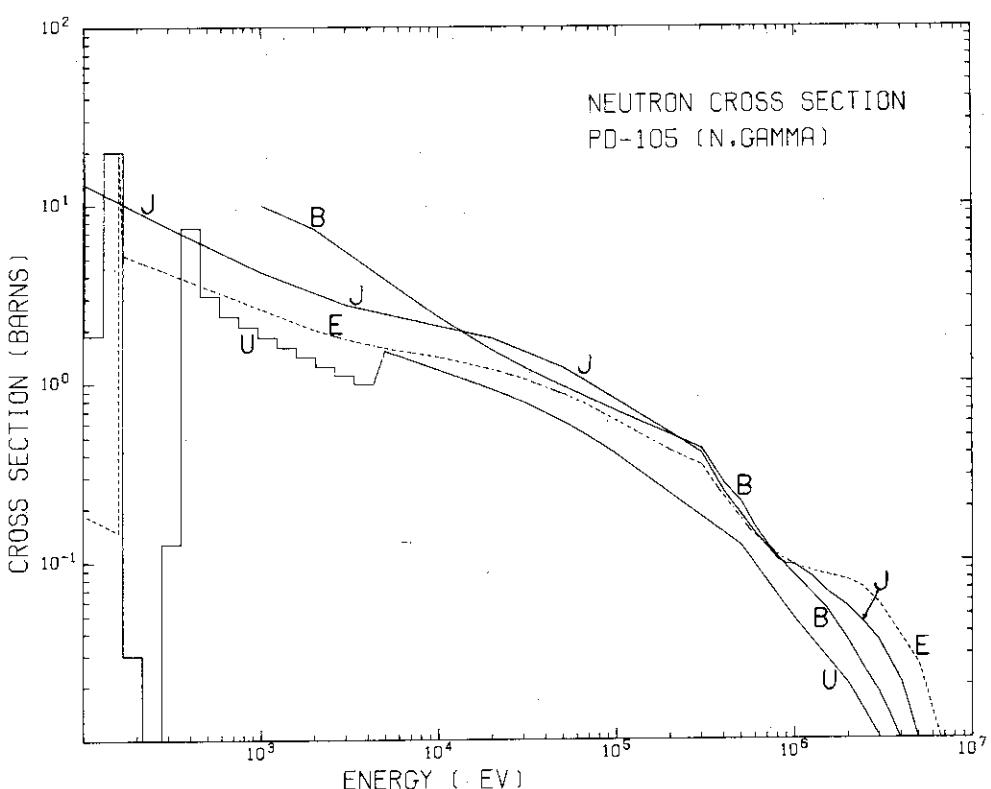


Fig A · 3(b)-11

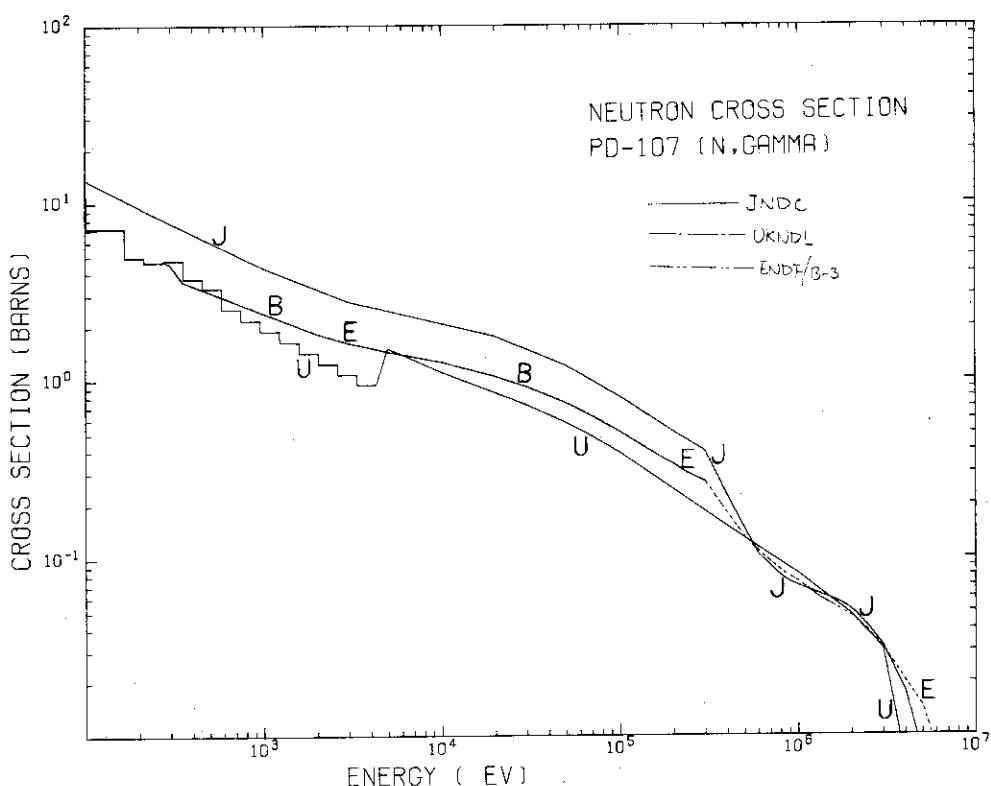


Fig A · 3(b)-12

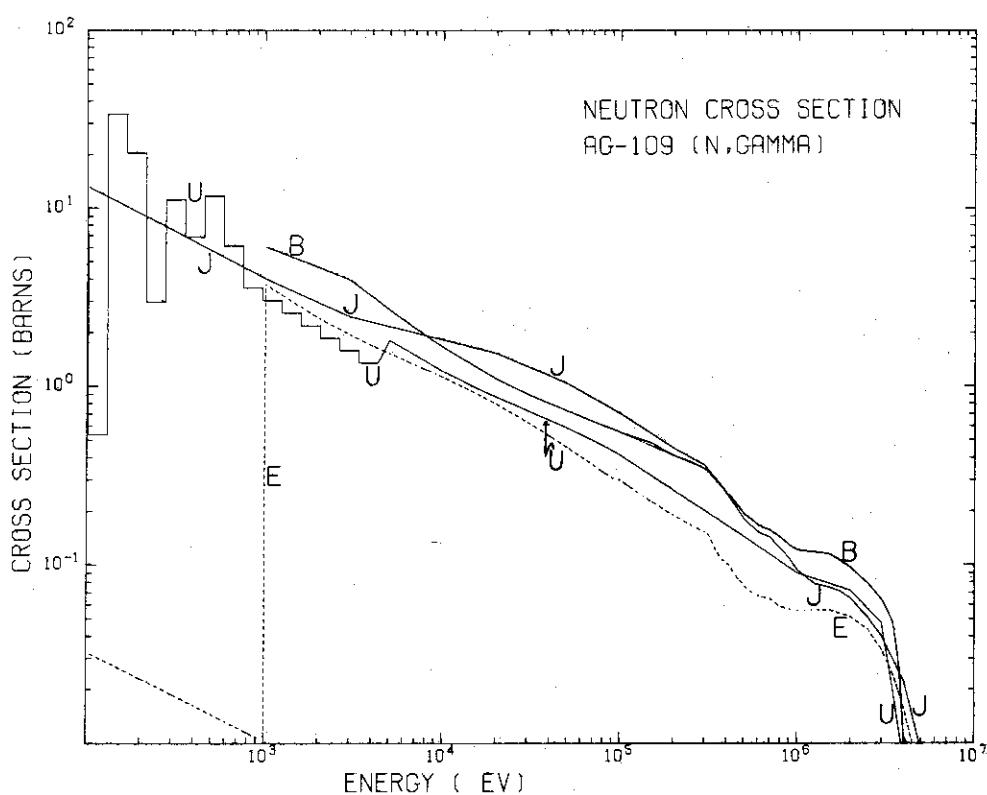


Fig A·3(b)-13

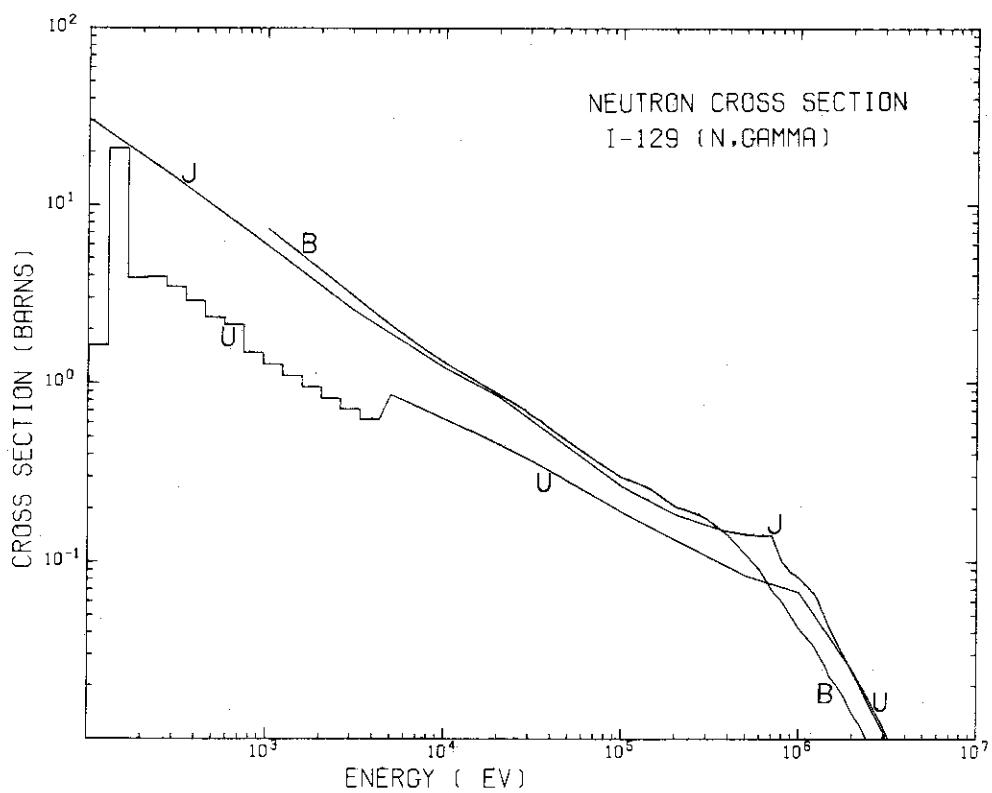


Fig A·3(b)-14

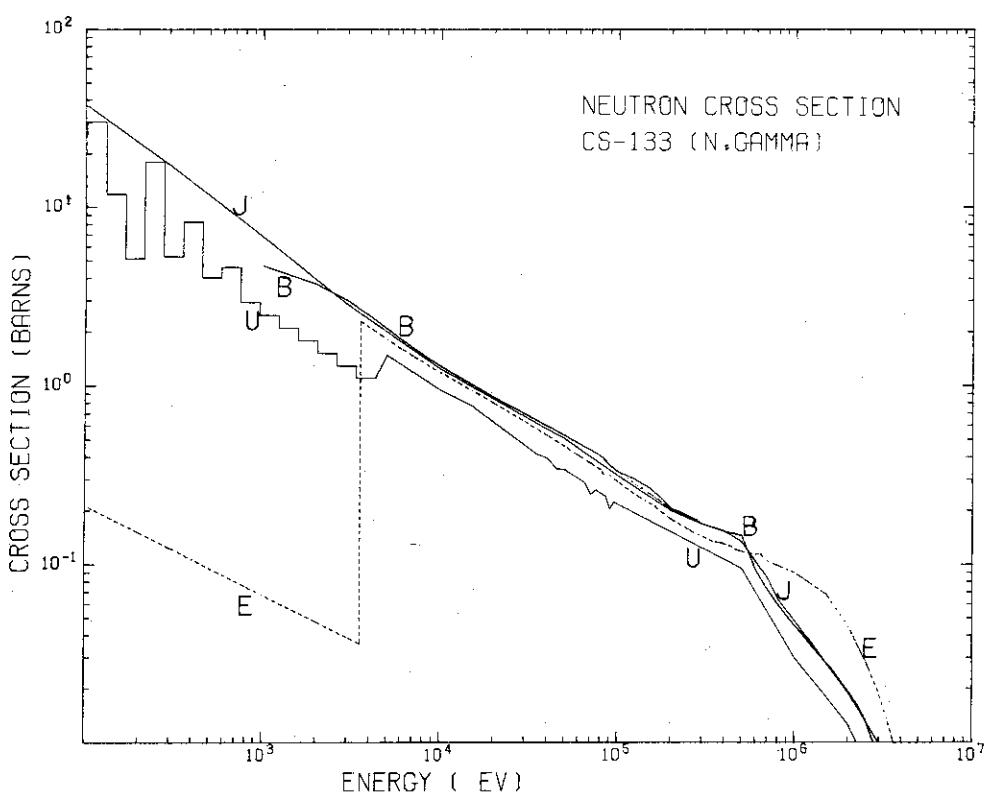


Fig A·3(b)-15

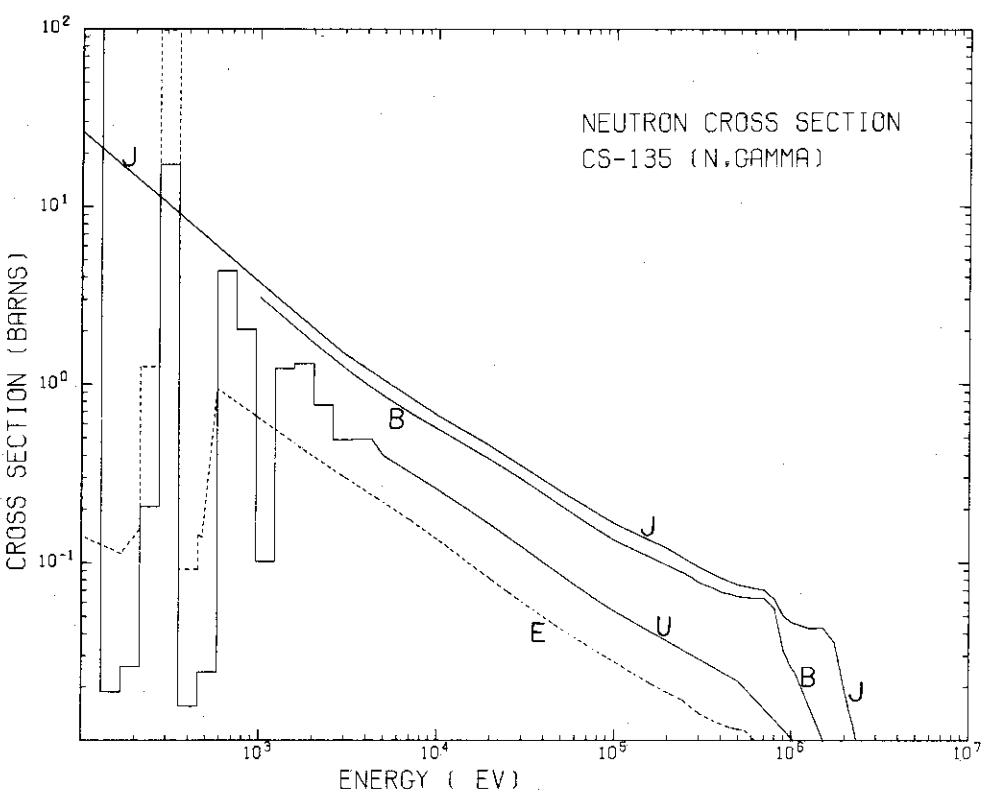


Fig A·3(b)-16

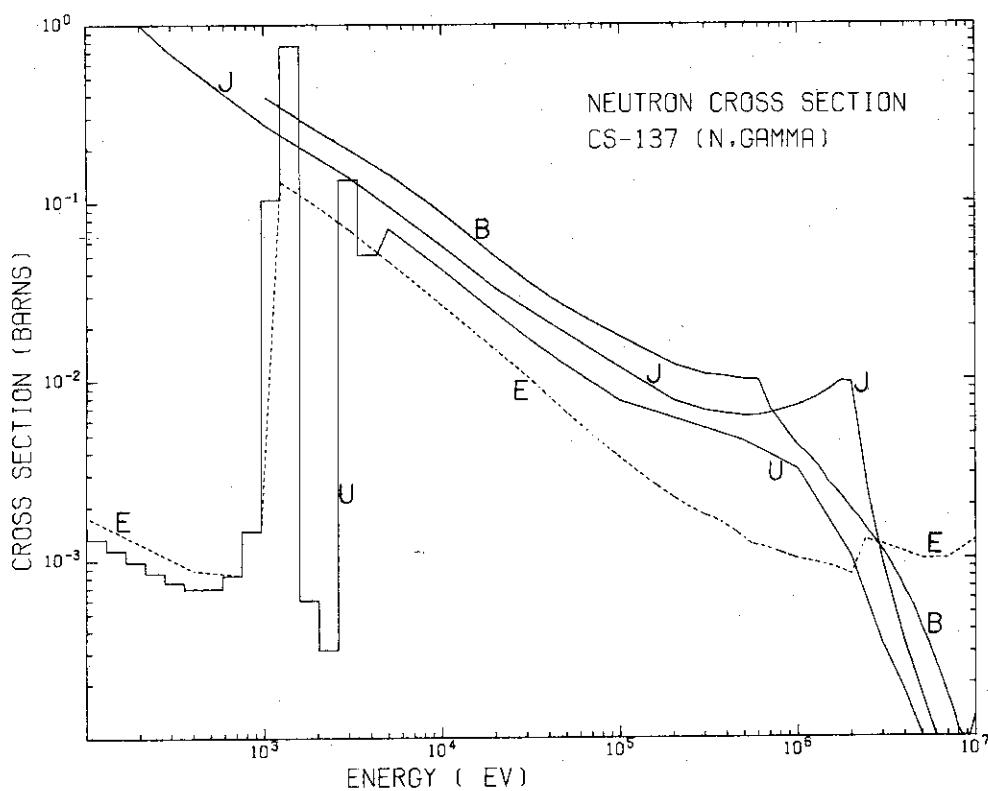


Fig A · 3(b)-17

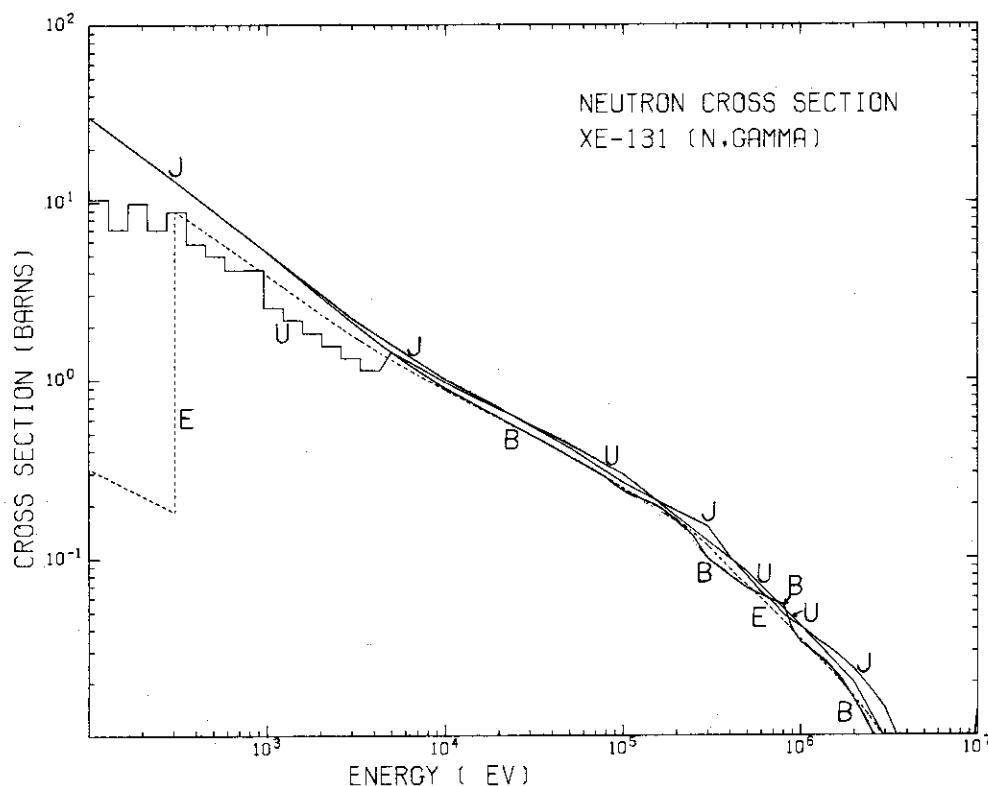


Fig A · 3(b)-18

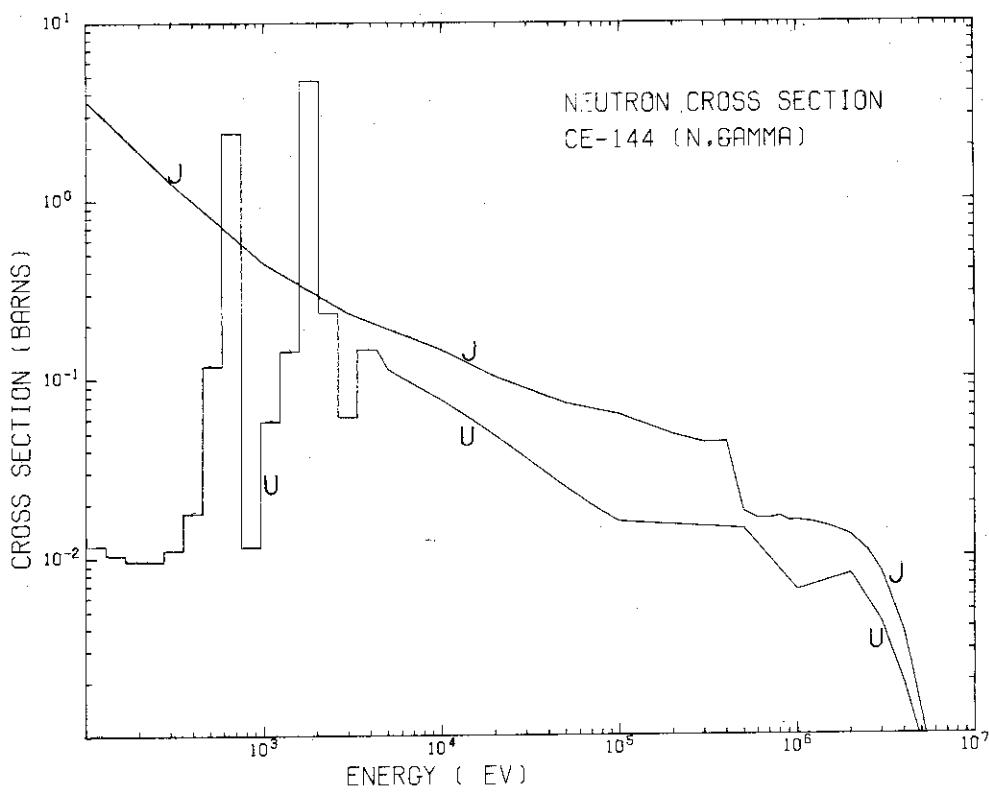


Fig A · 3(b)-19

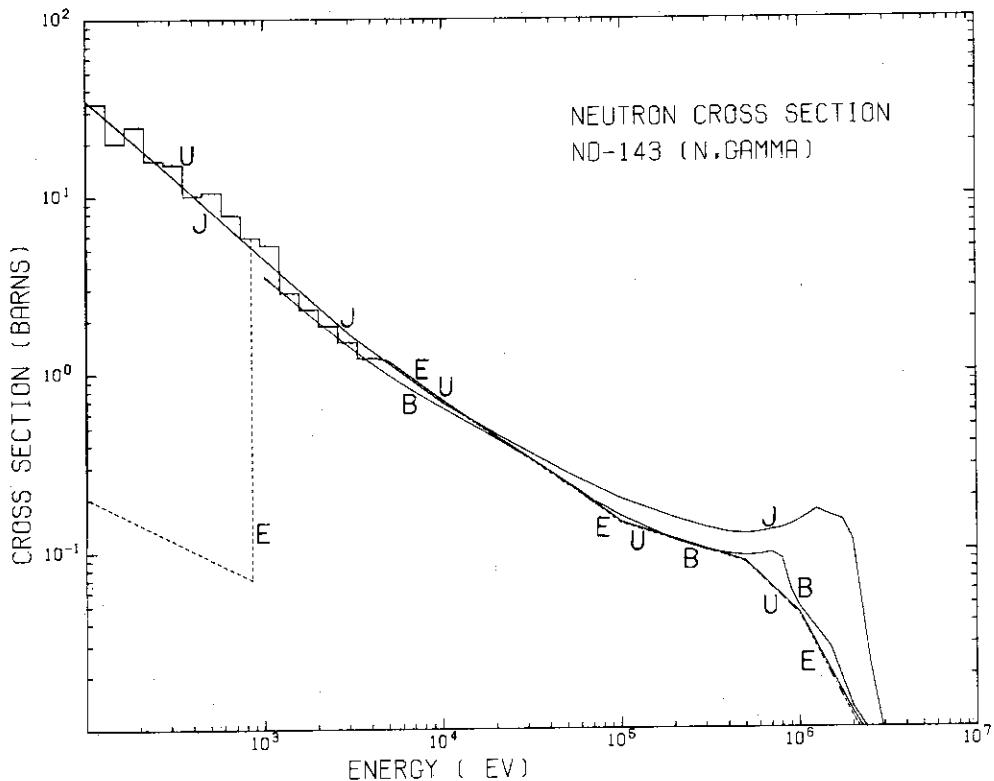


Fig A · 3(b)-20

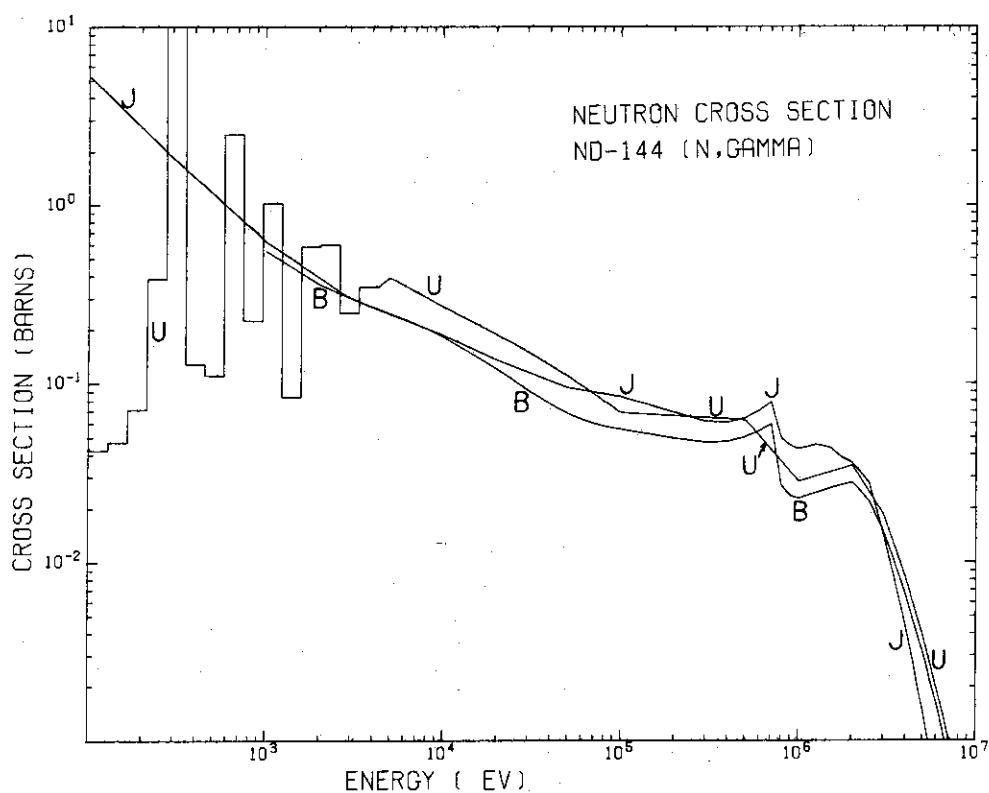


Fig A · 3(b)-21

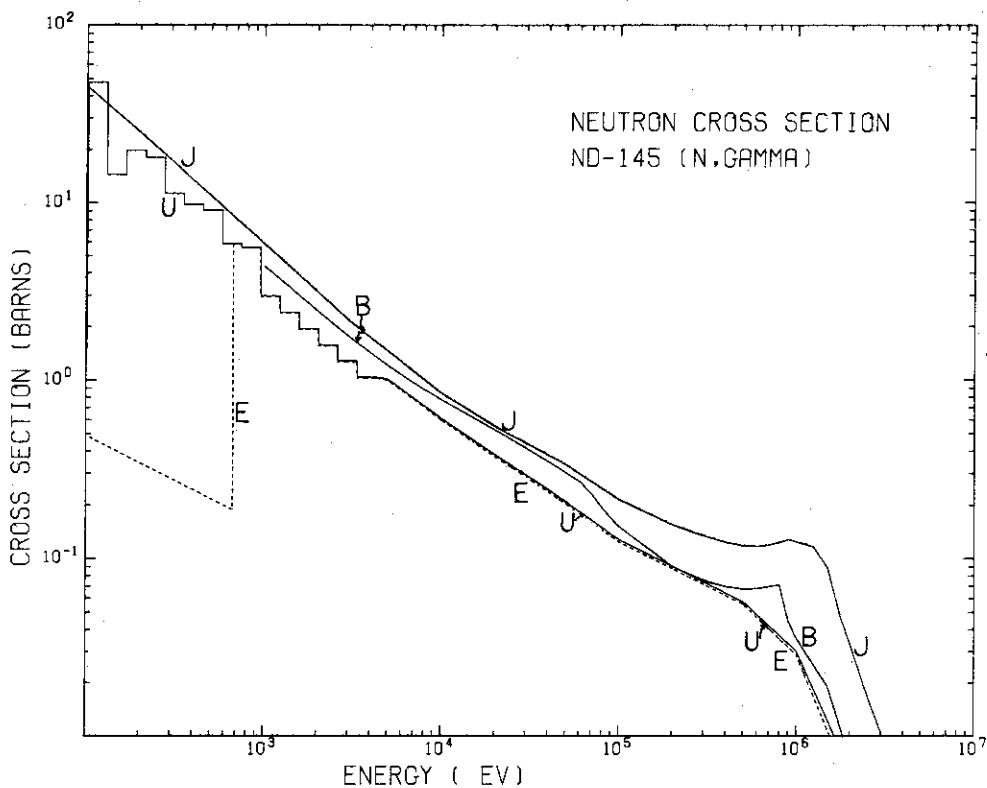


Fig A · 3(b)-22

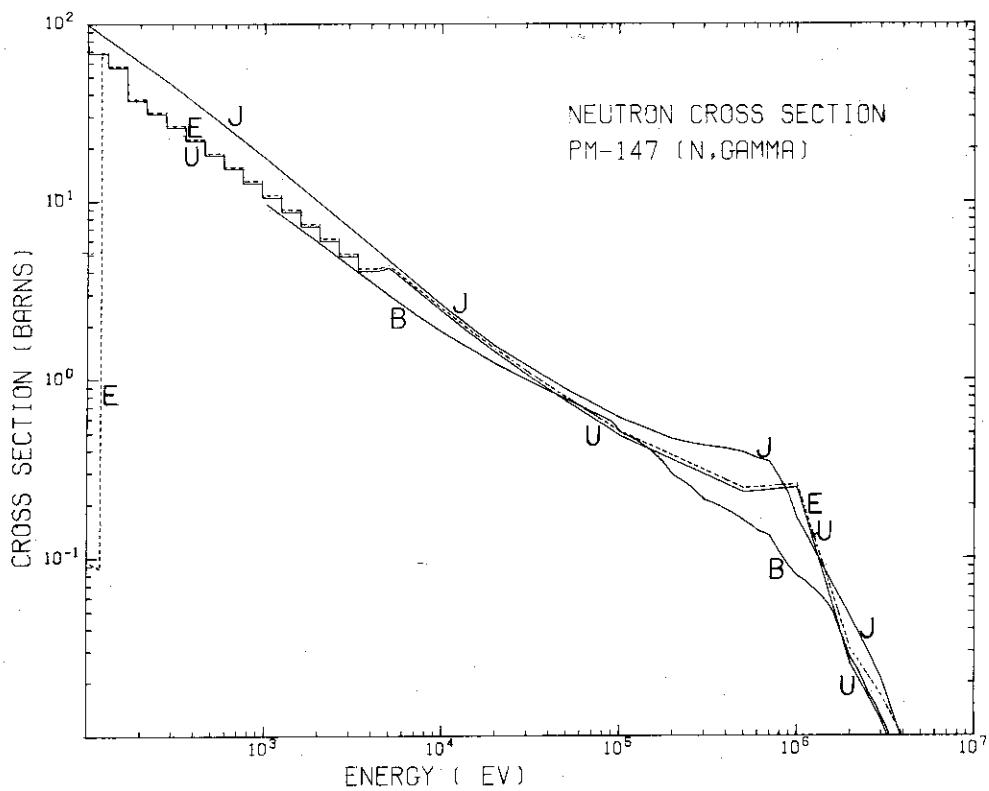


Fig. A·3(b)-23

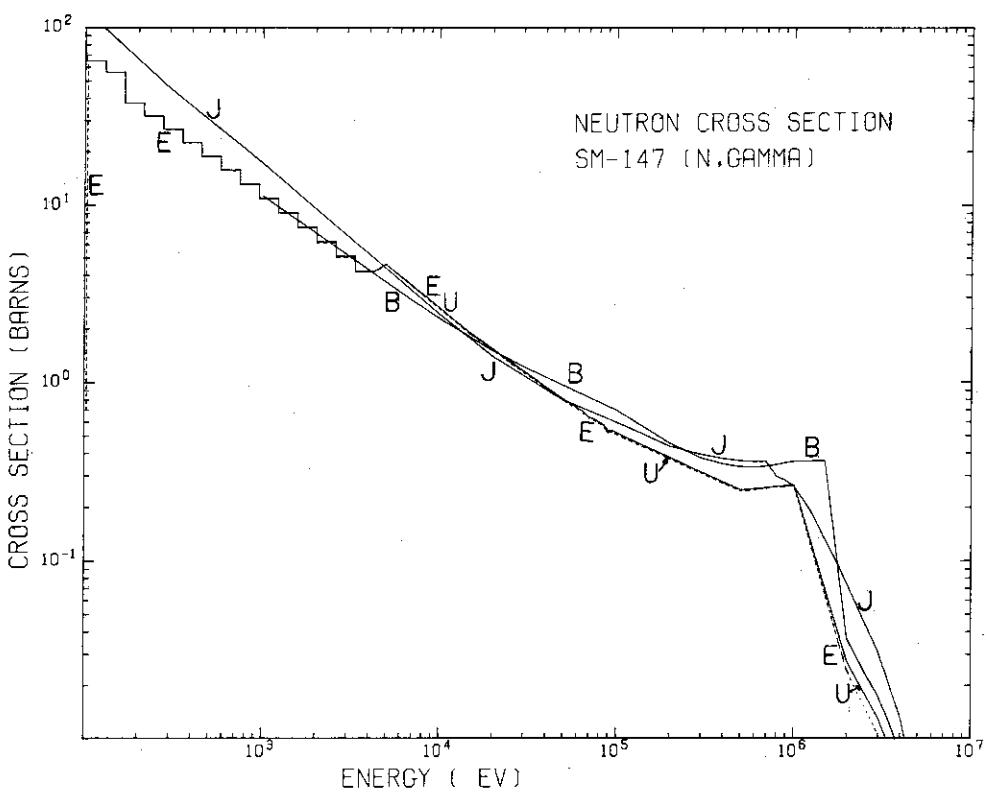


Fig. A·3(b)-24

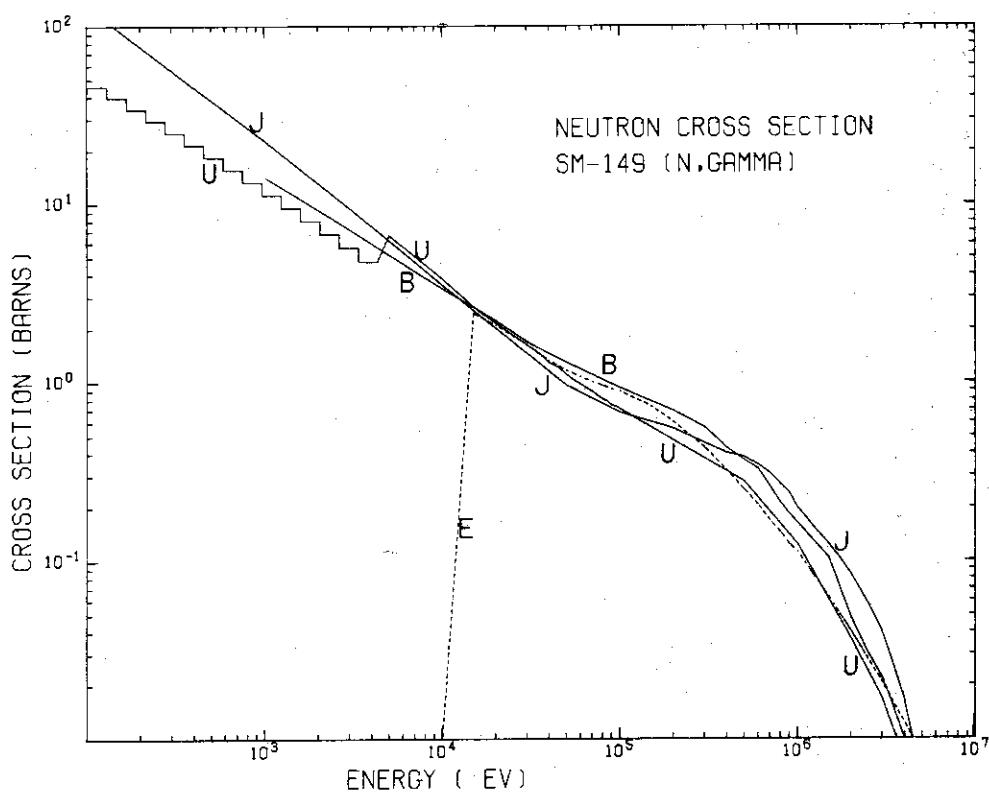


Fig A · 3(b)-25

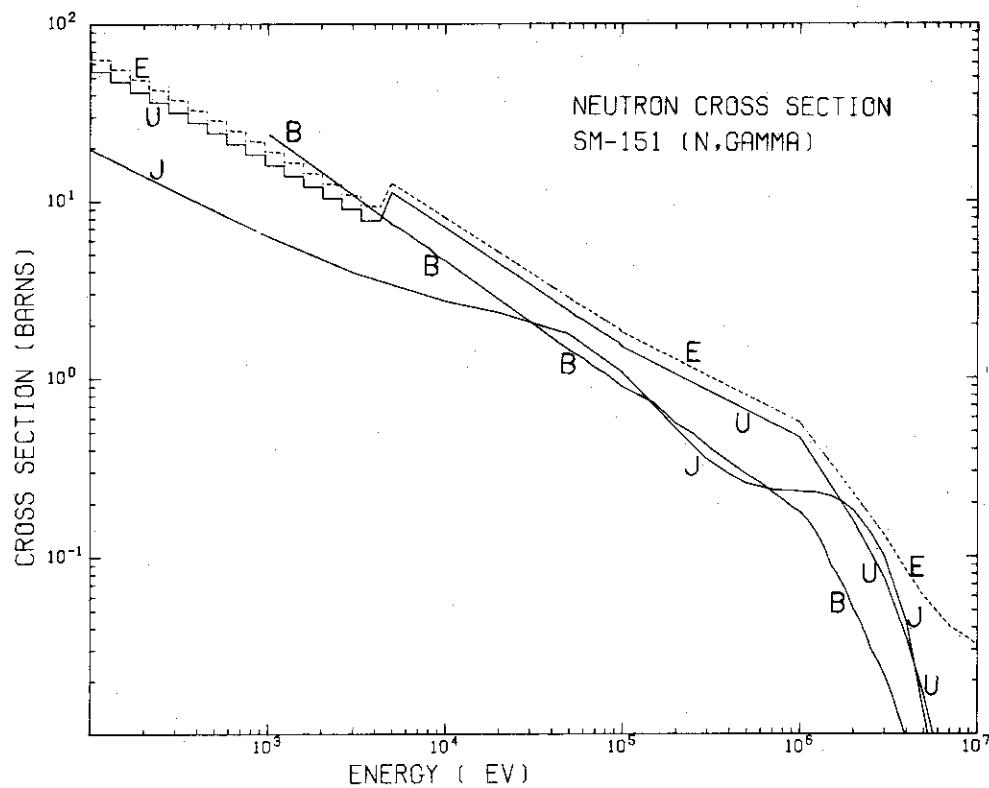


Fig A · 3(b)-26

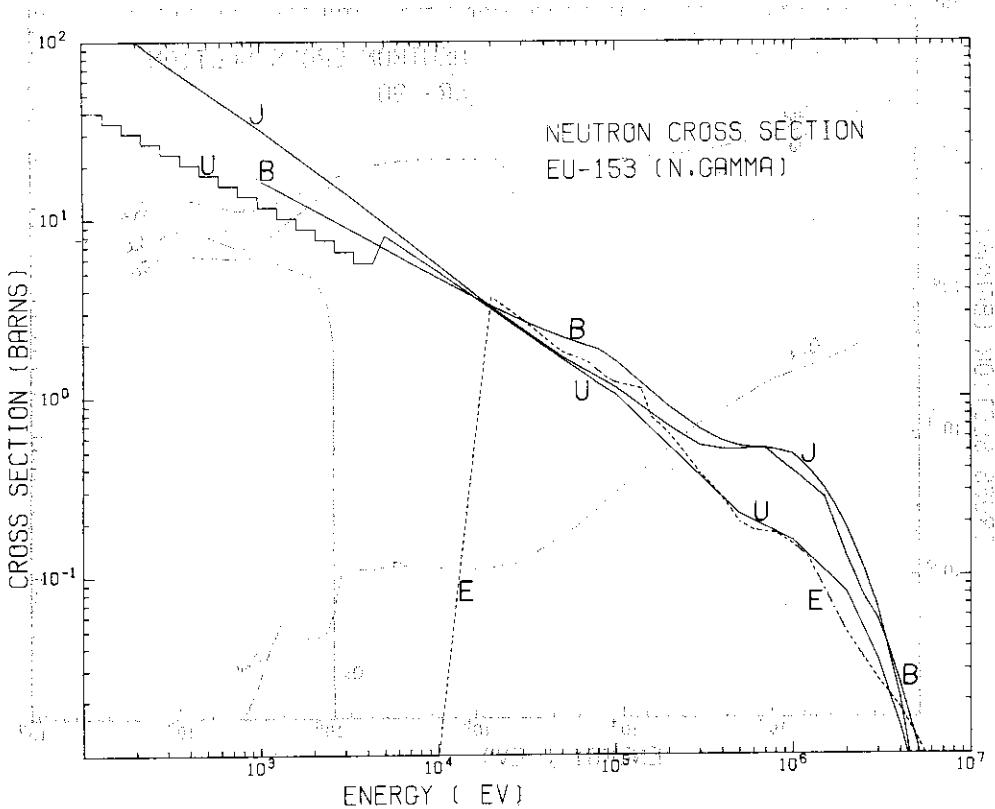


Fig A · 3(b)-27

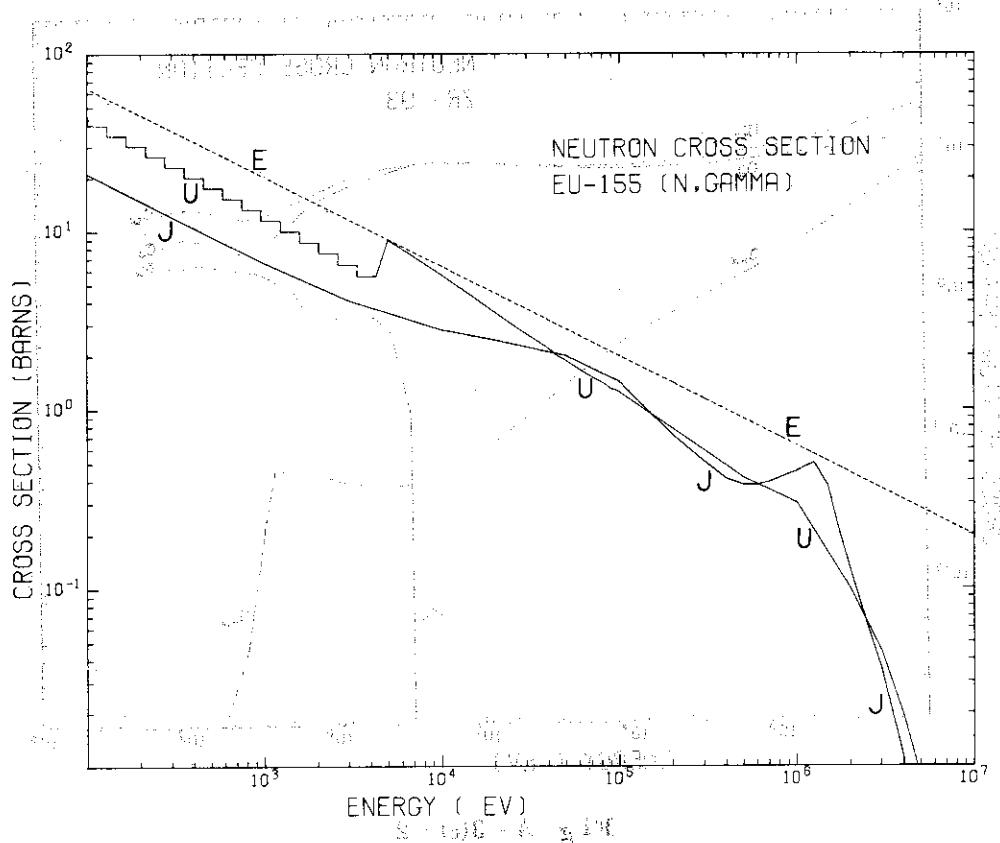


Fig A · 3(b)-28

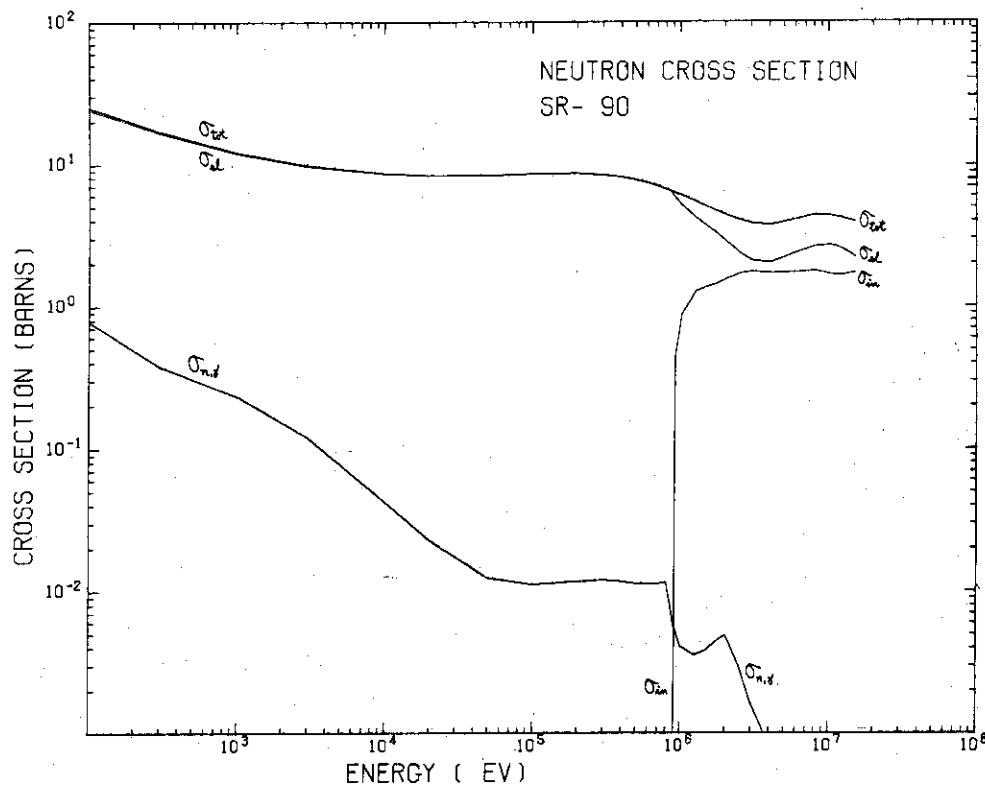


Fig A · 3(c)-1

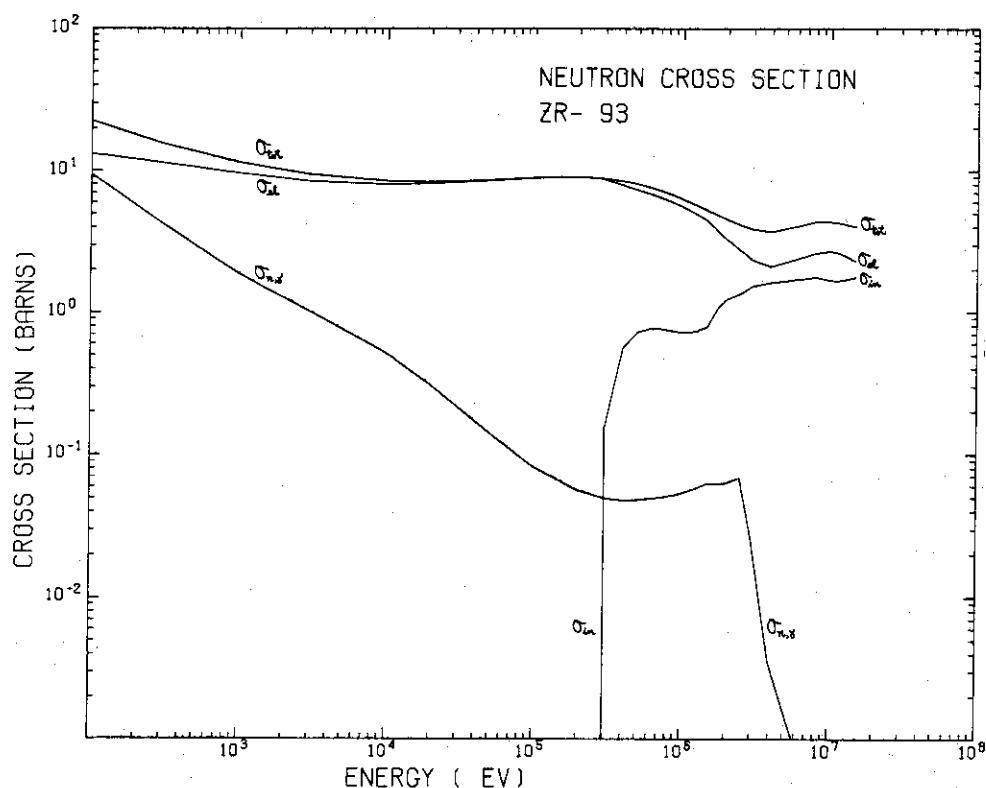


Fig A · 3(c)-2

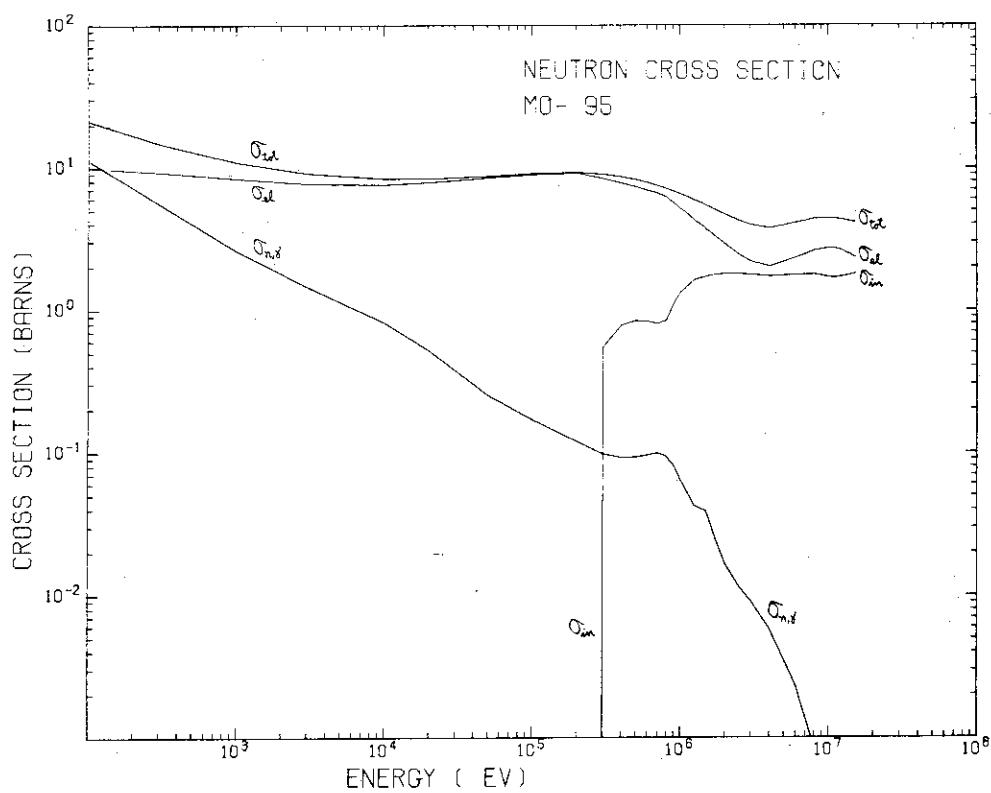


Fig. A · 3(c)-3

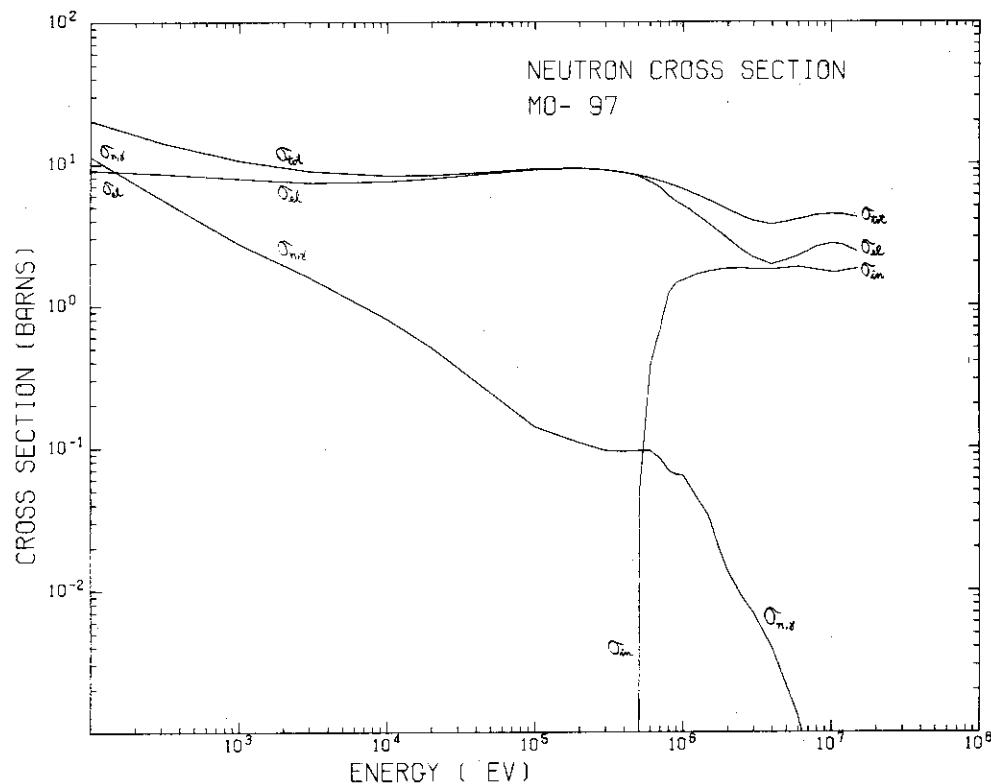


Fig. A · 3(c)-4

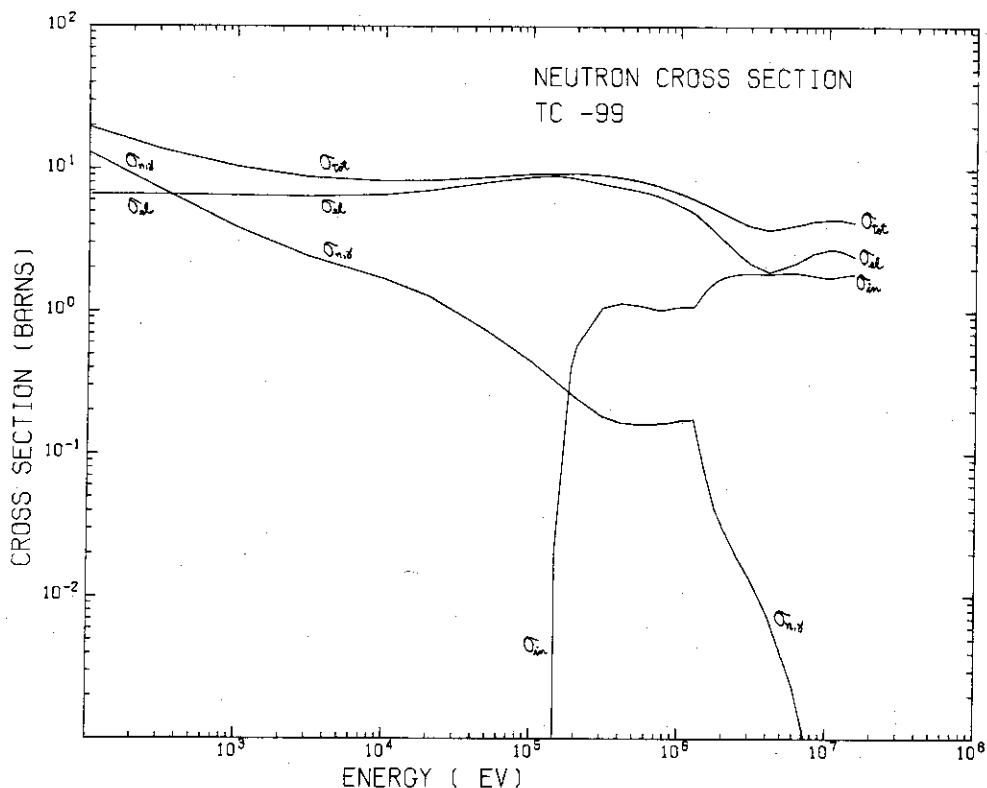


Fig A · 3(c)-5

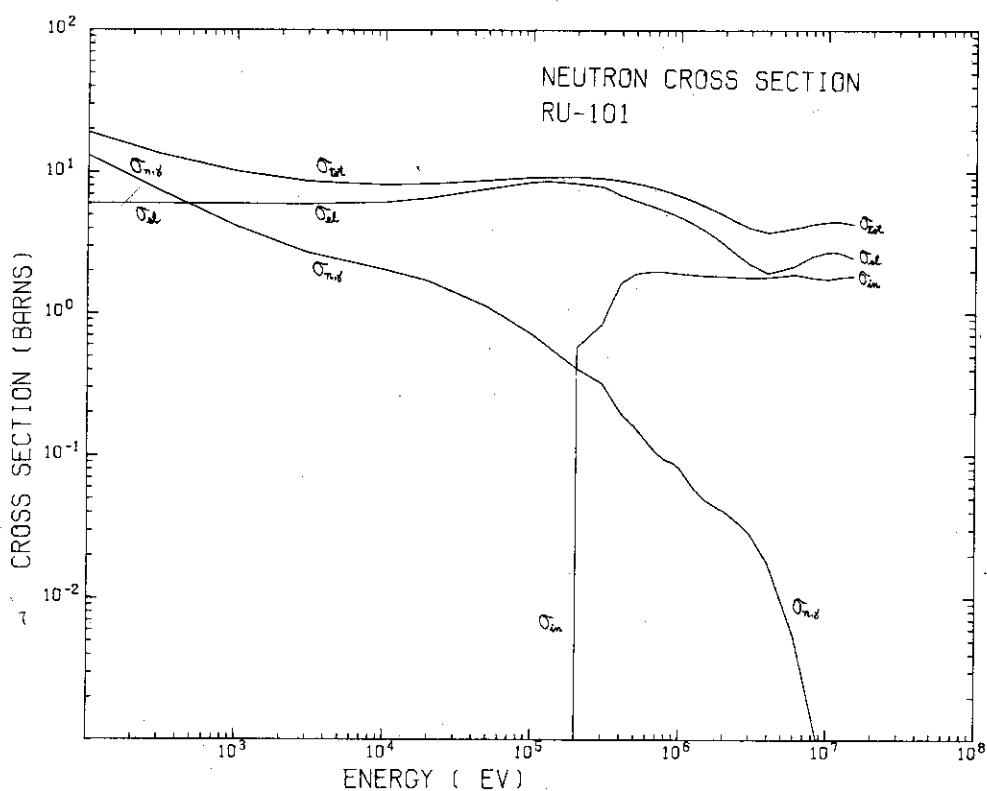


Fig A · 3(c)-6

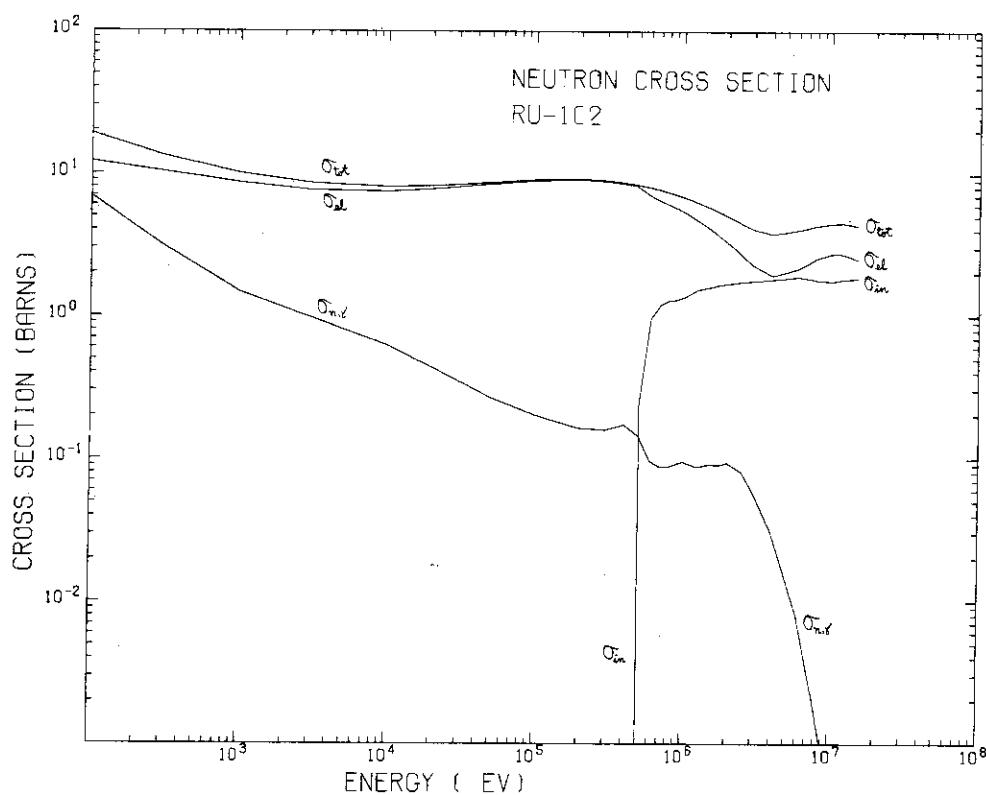


Fig A · 3(c)-7

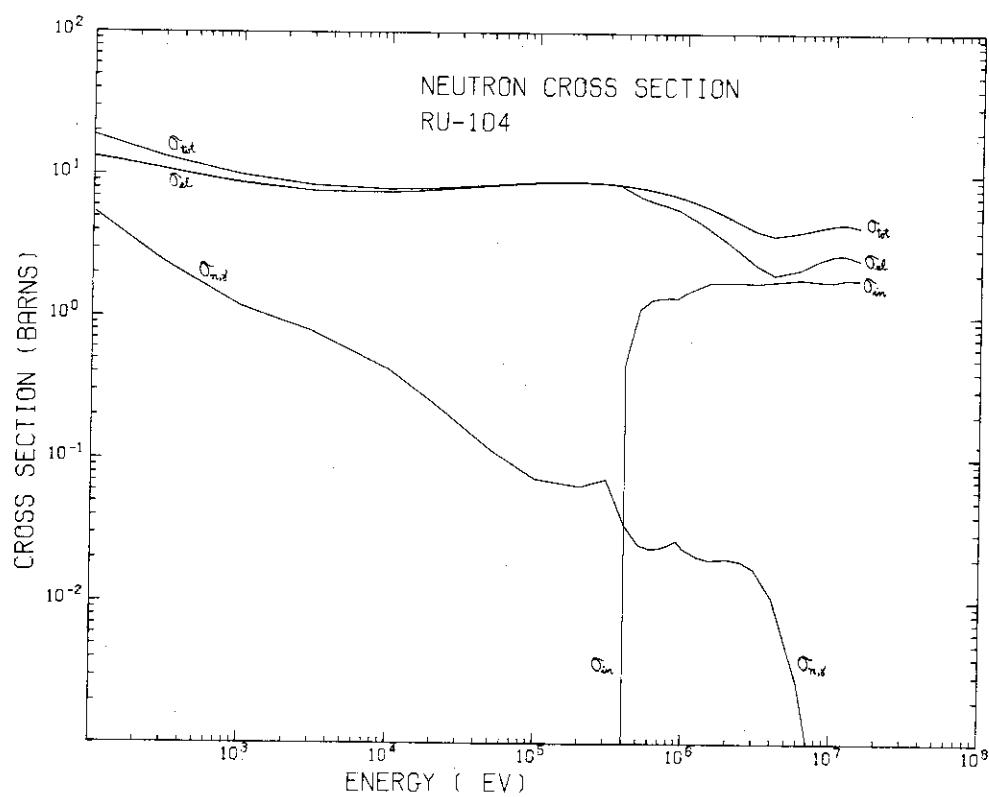


Fig A · 3(c)-8

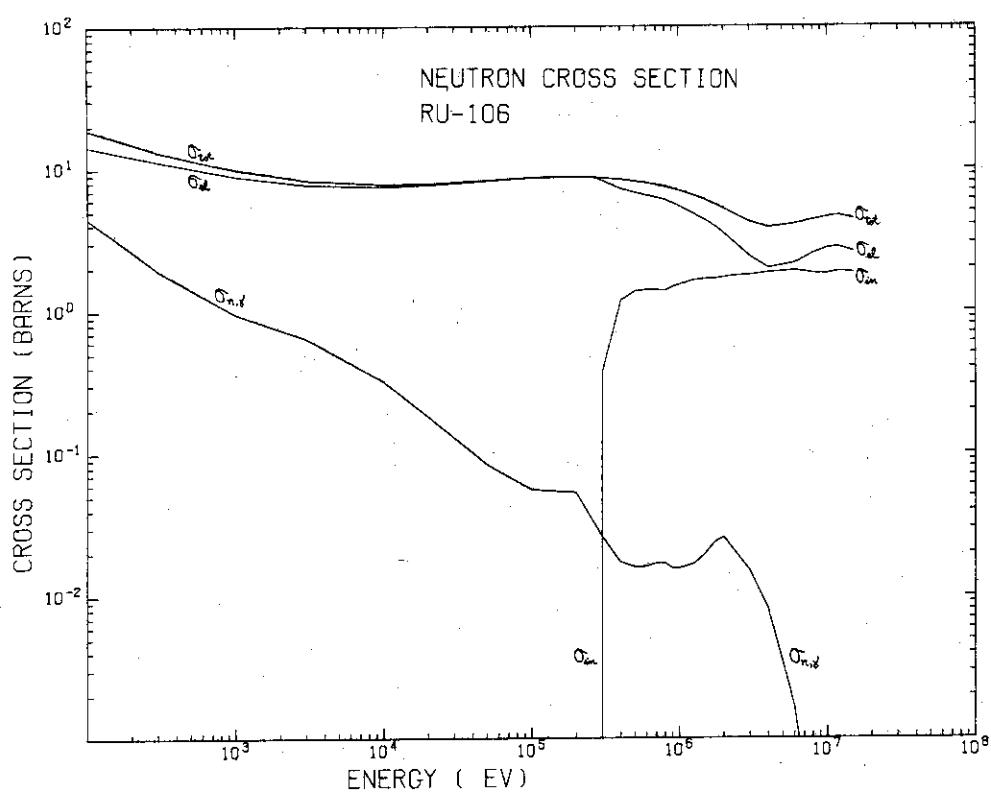


Fig A · 3(c)-9

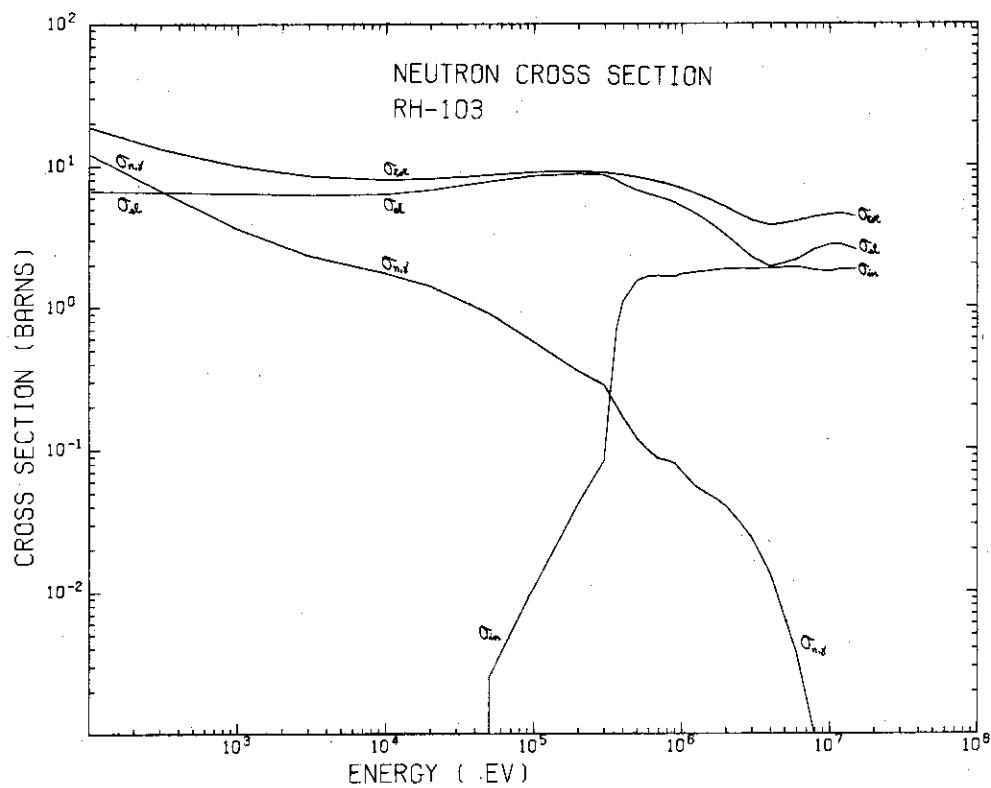


Fig A · 3(c)-10

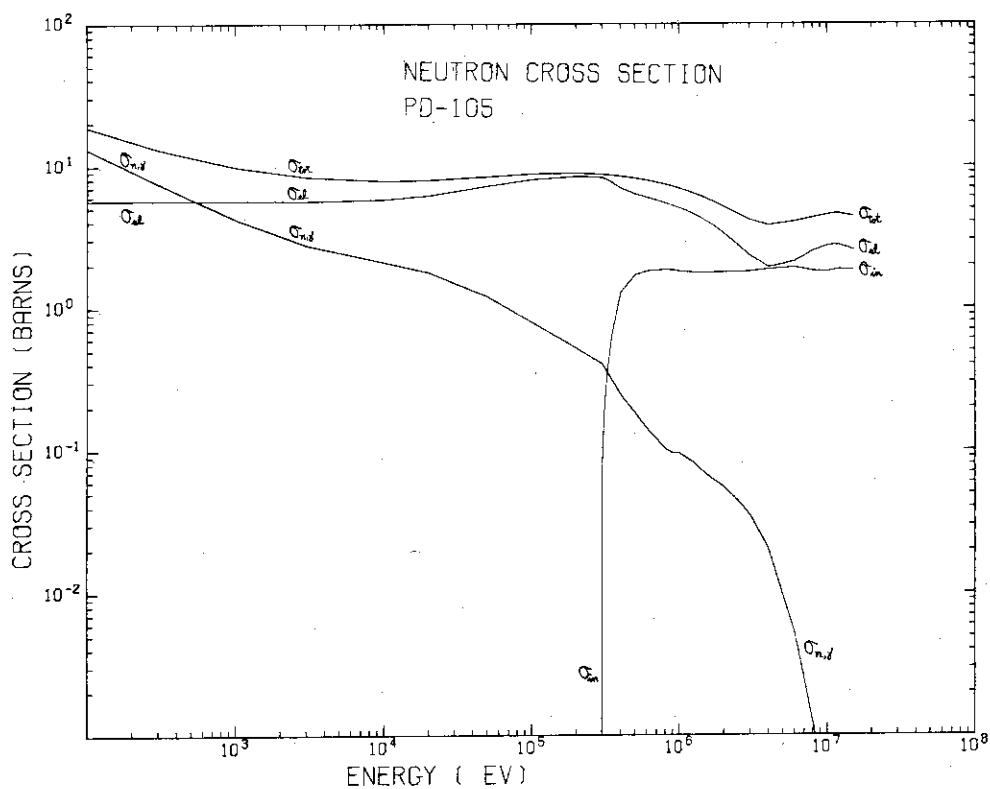


Fig A · 3(c)-11

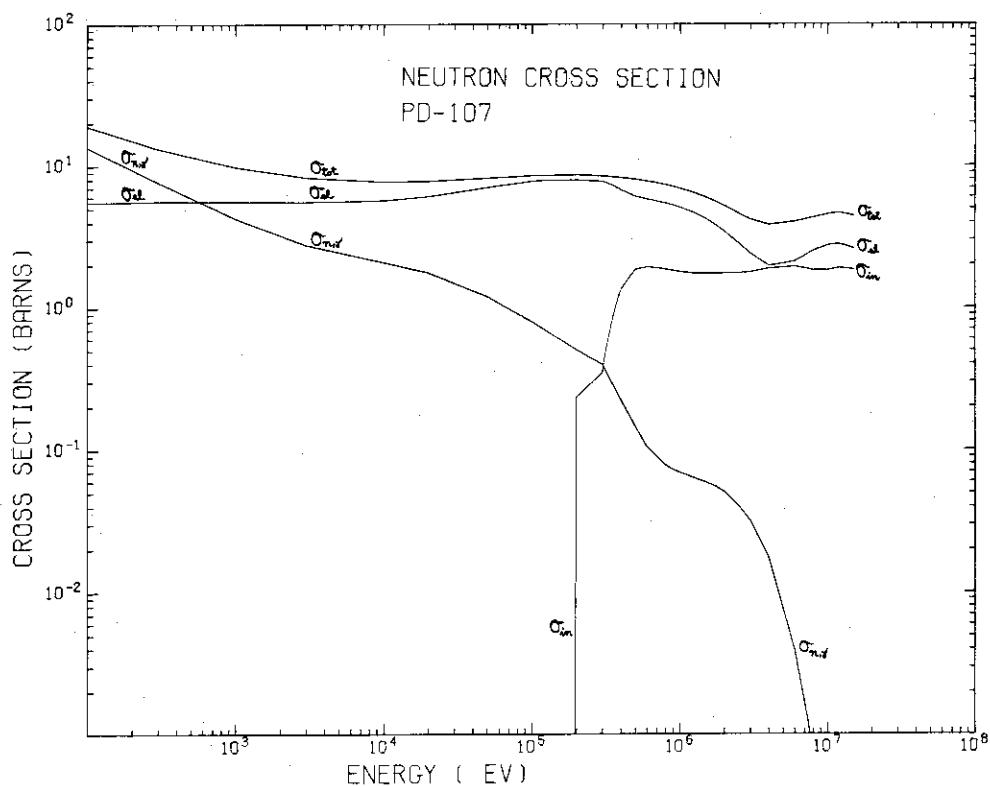


Fig A · 3(c)-12

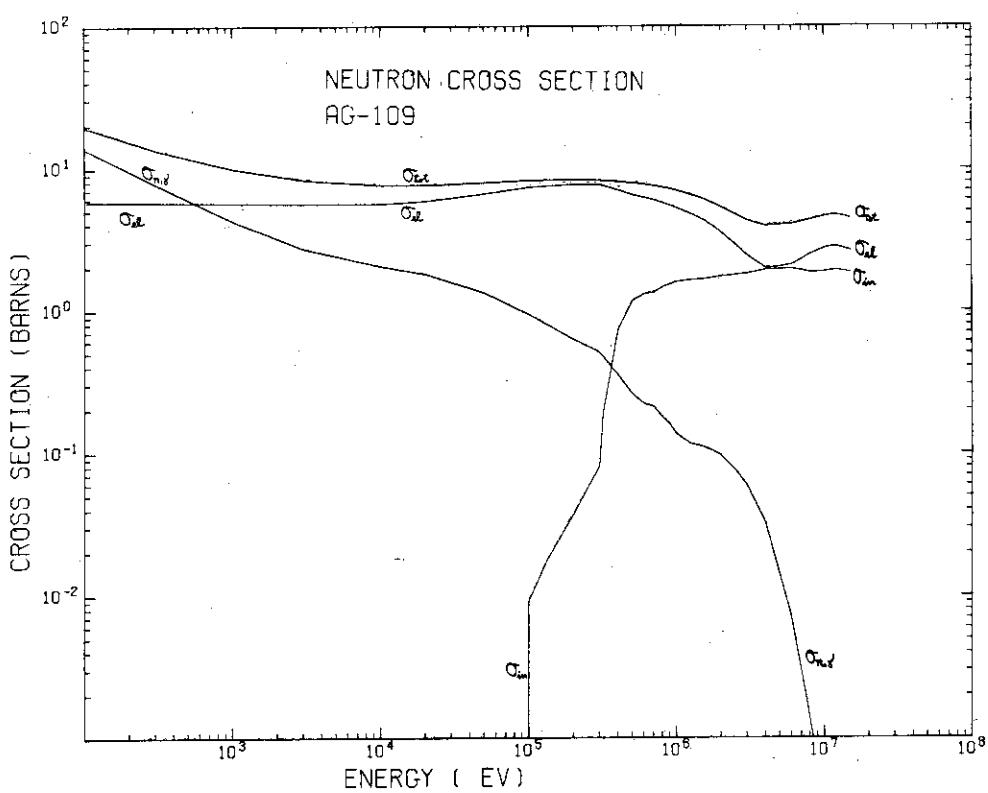


Fig A · 3(c)-1.3

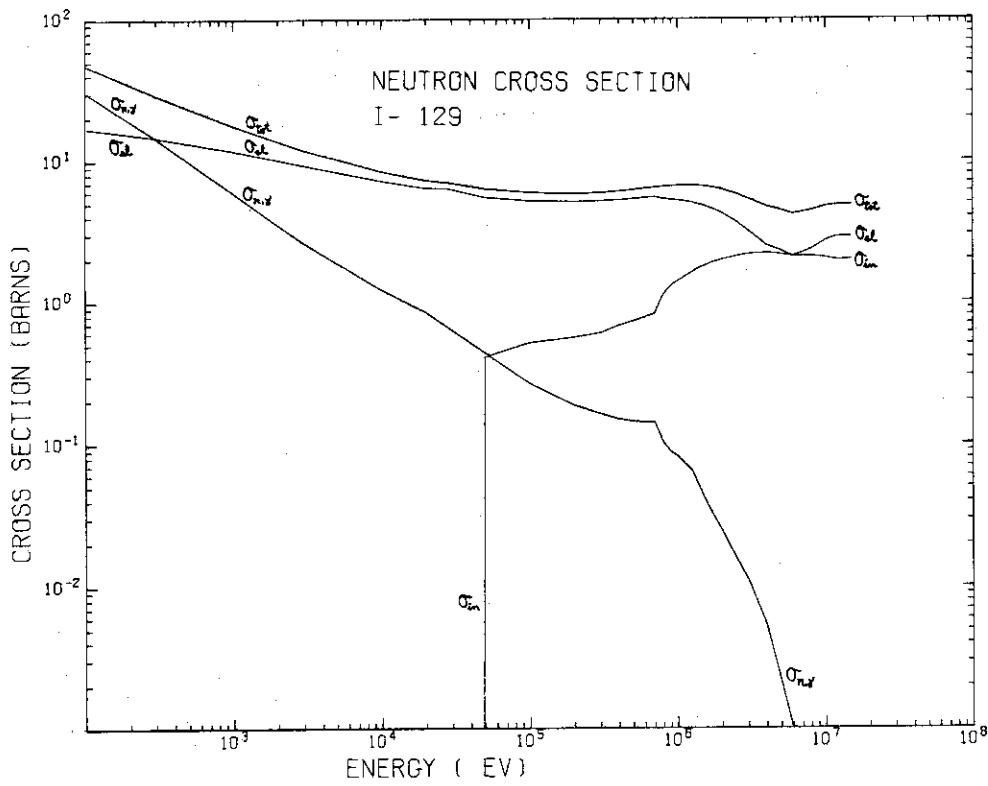


Fig A · 3(c)-1.4

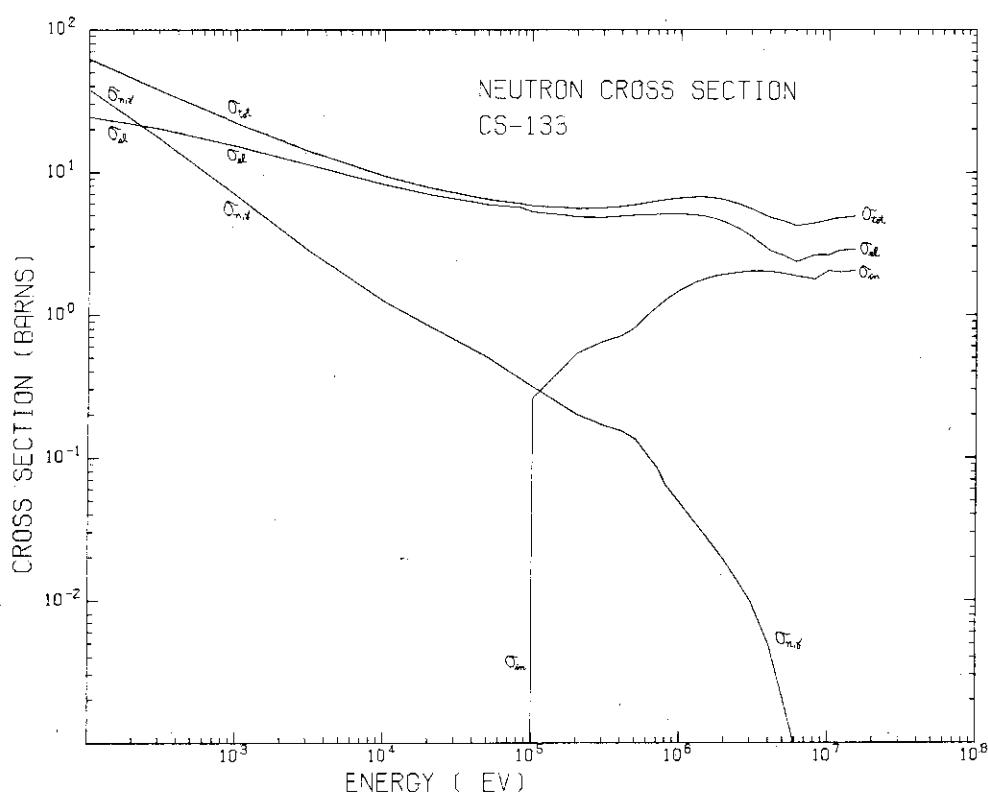


Fig A·3(c)-15

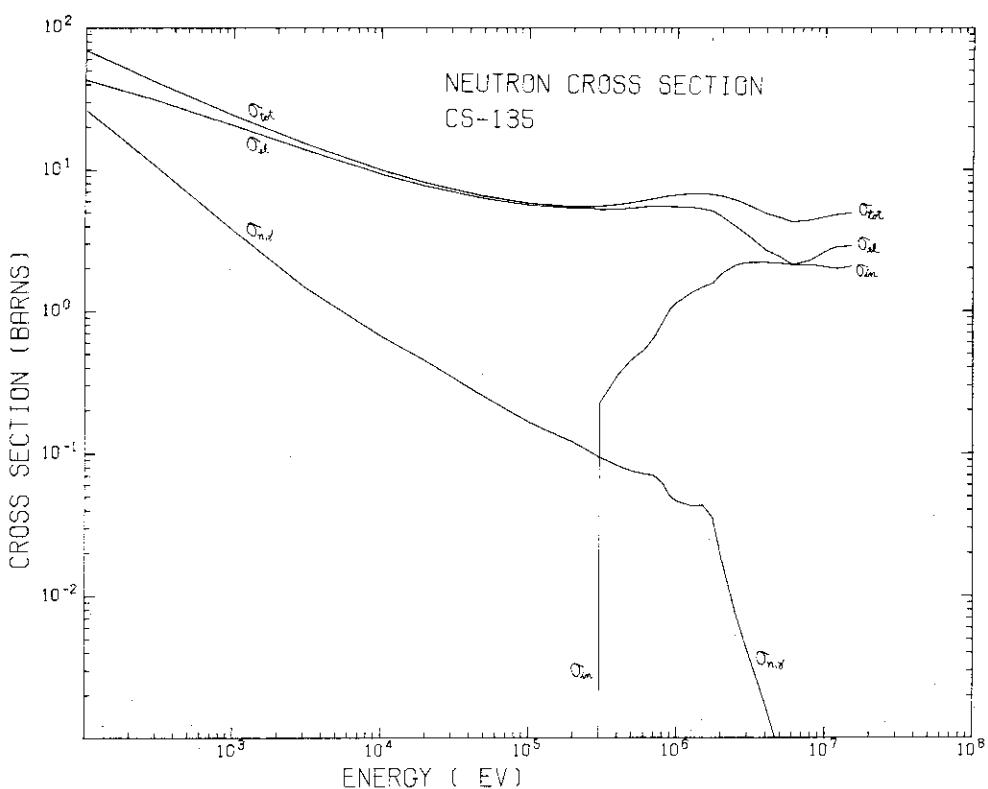


Fig A·3(c)-16

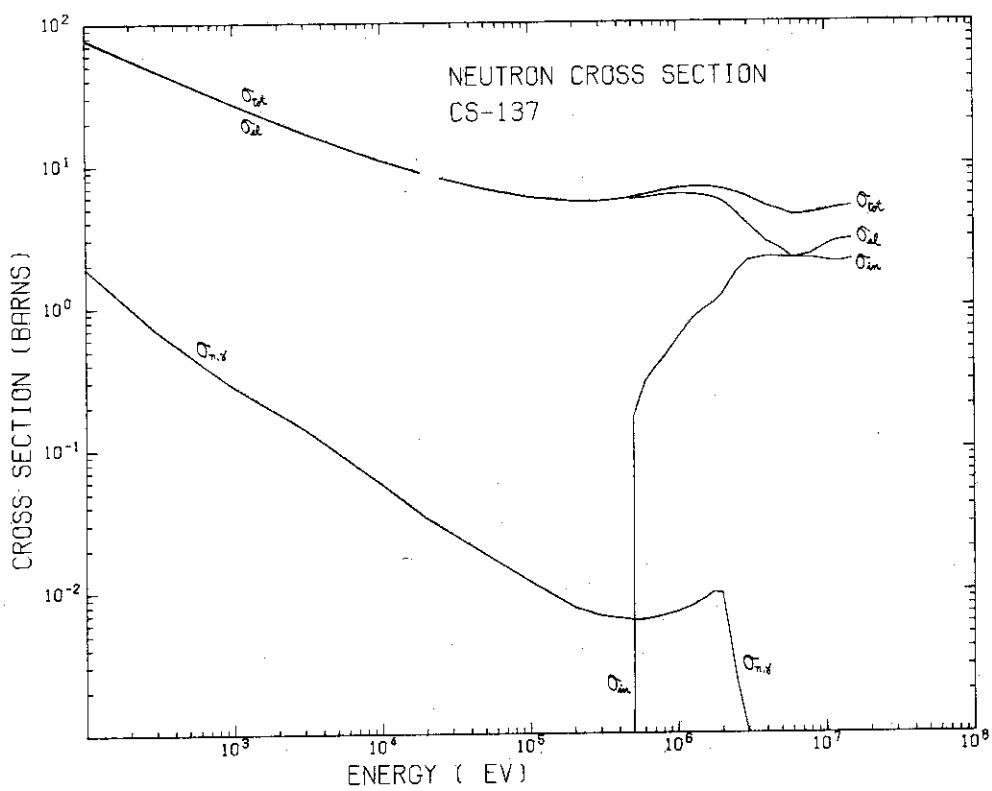


Fig A · 3(c)-17

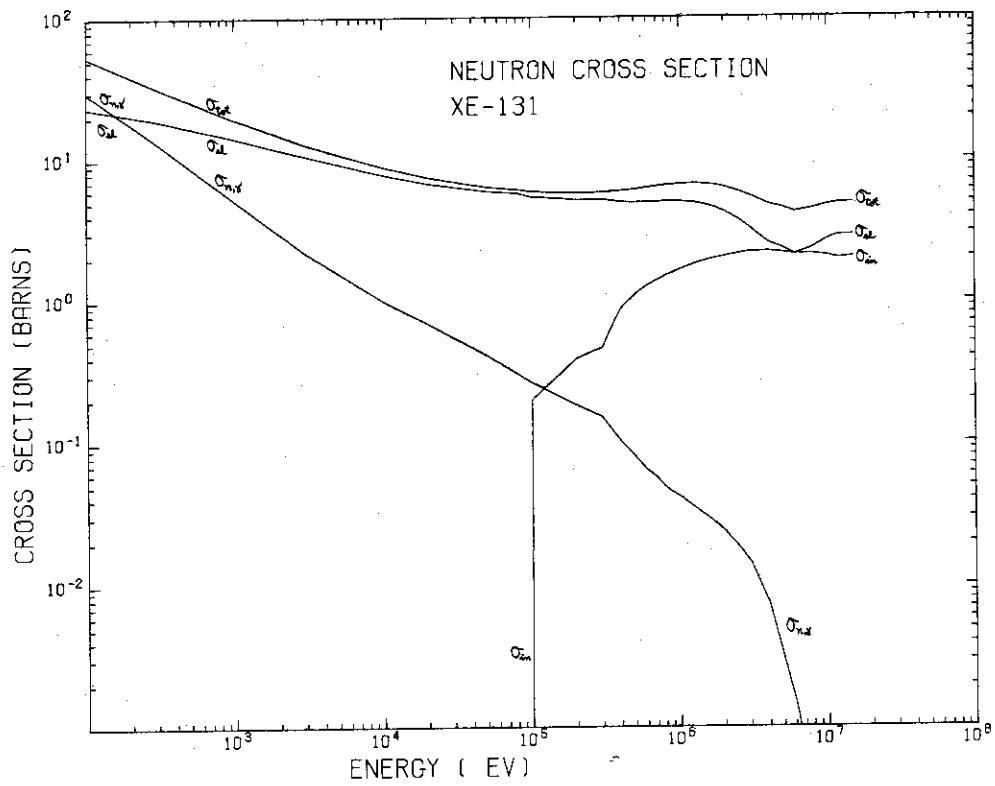


Fig A · 3(c)-18

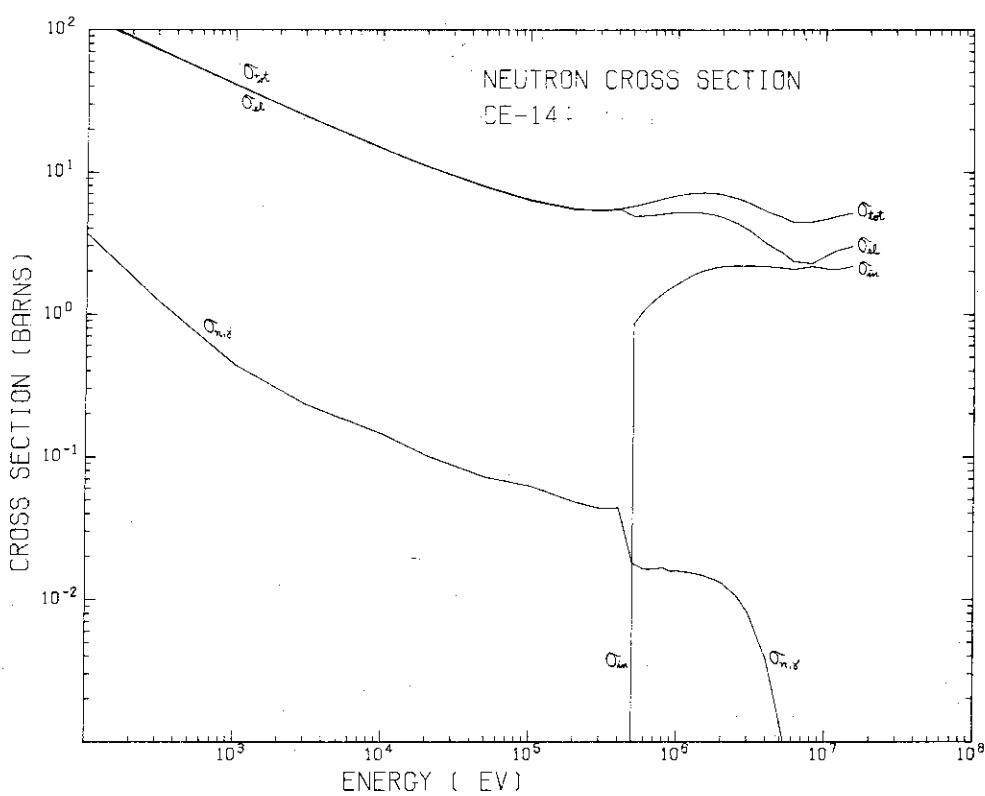


Fig A · 3(c)-19

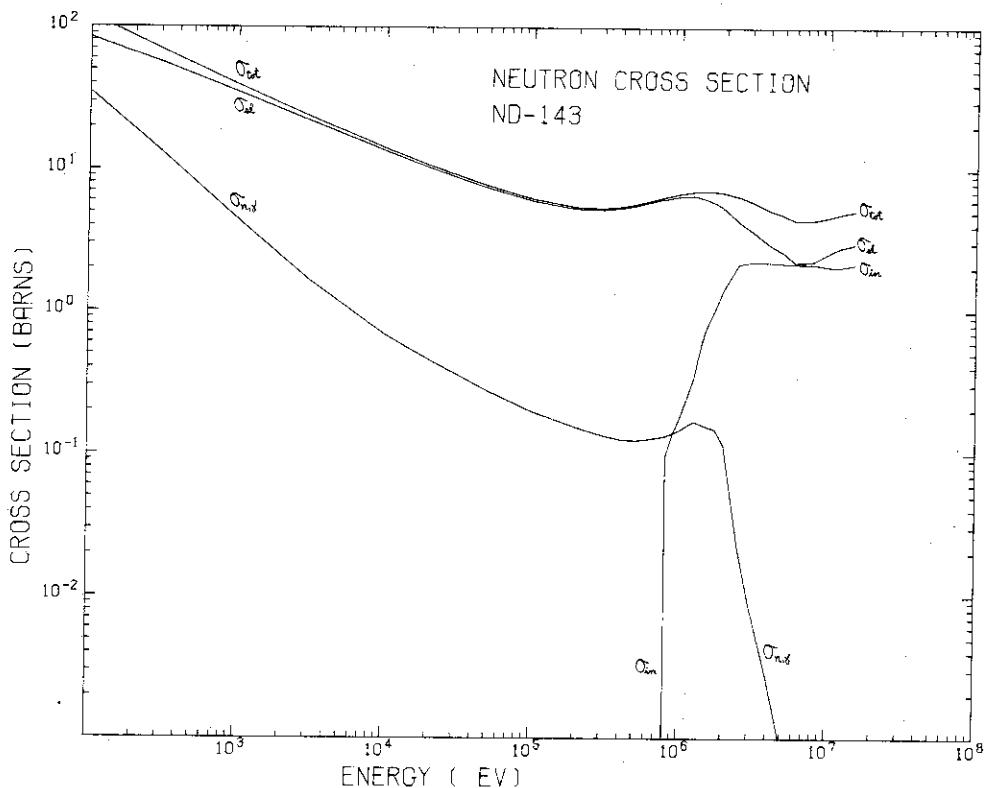


Fig A · 3(c)-20

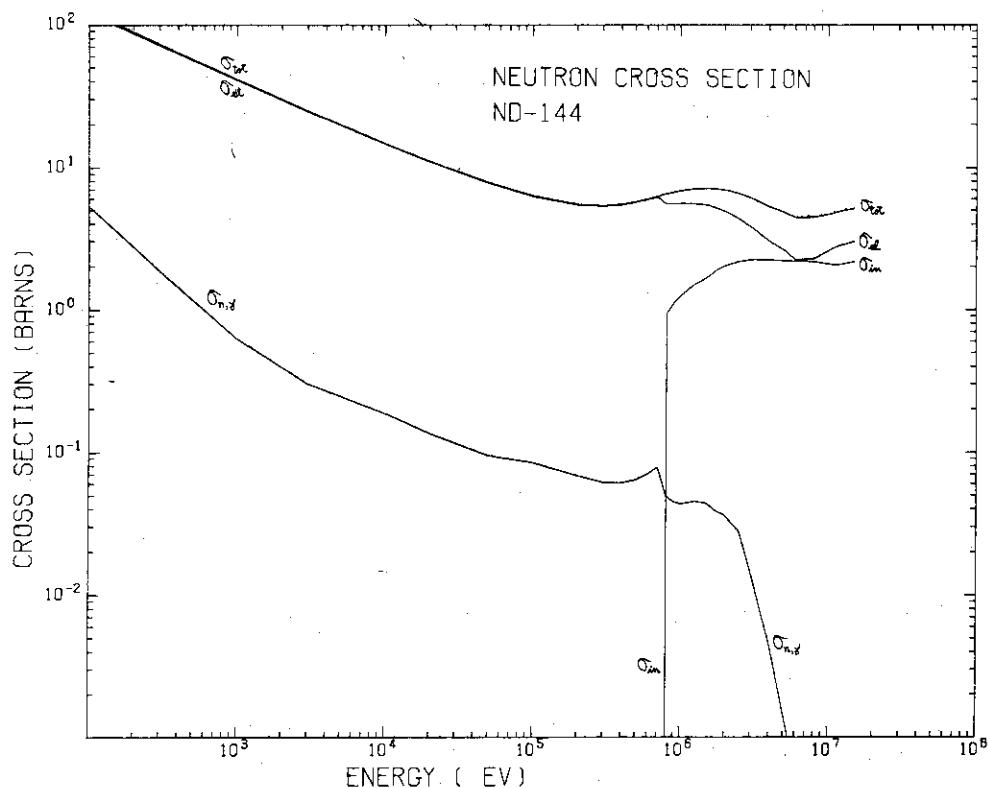


Fig A · 3(c)-2 1

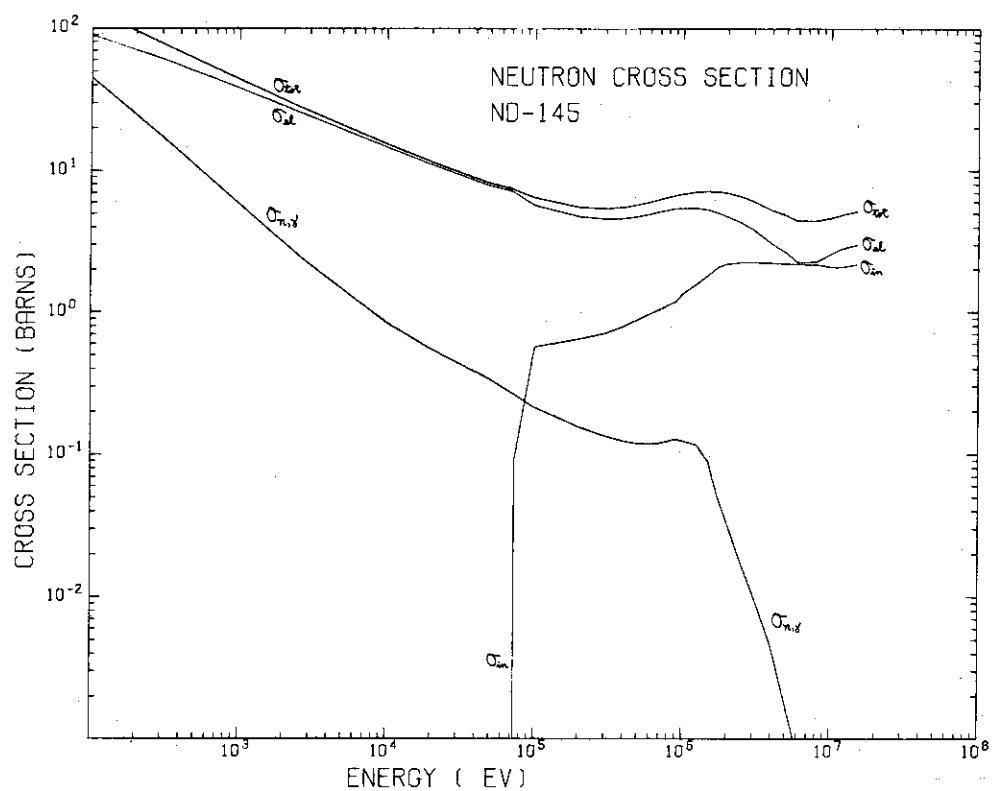


Fig A · 3(c)-2 2

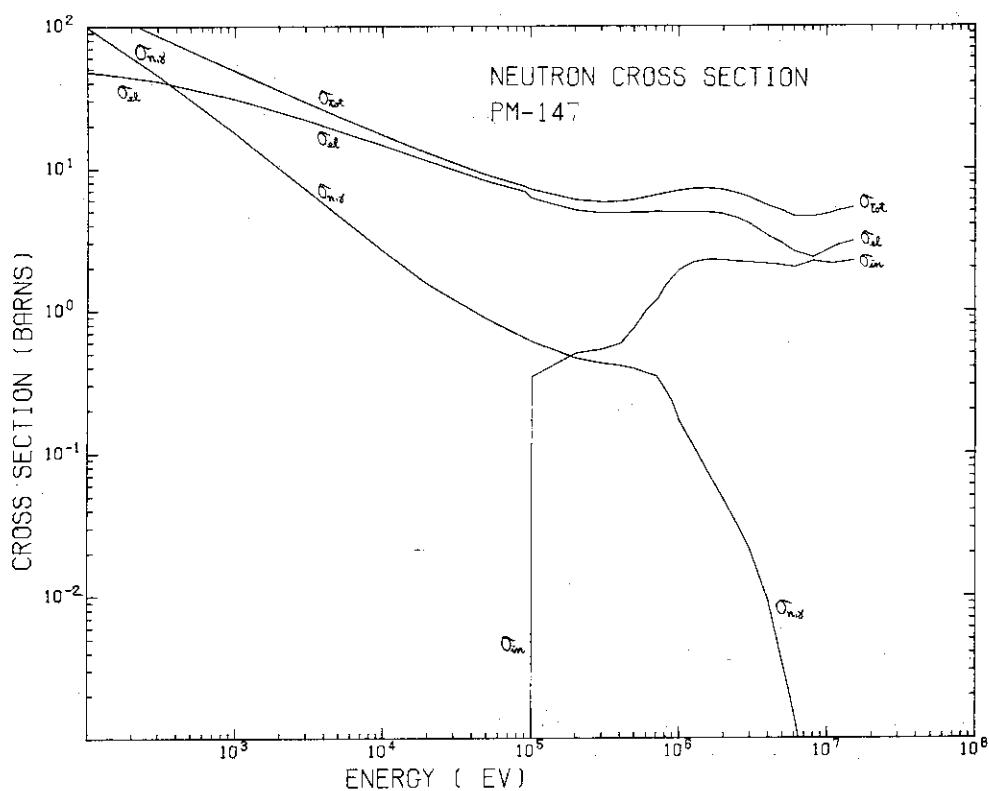


Fig A · 3(c)-23

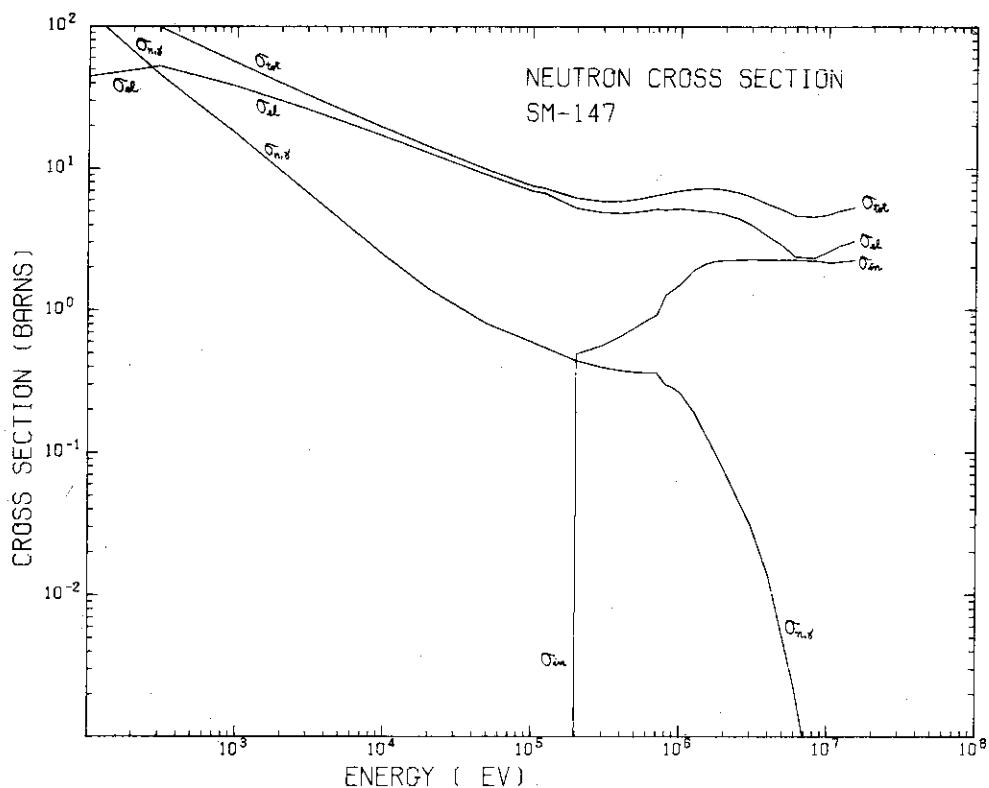


Fig A · 3(c)-24

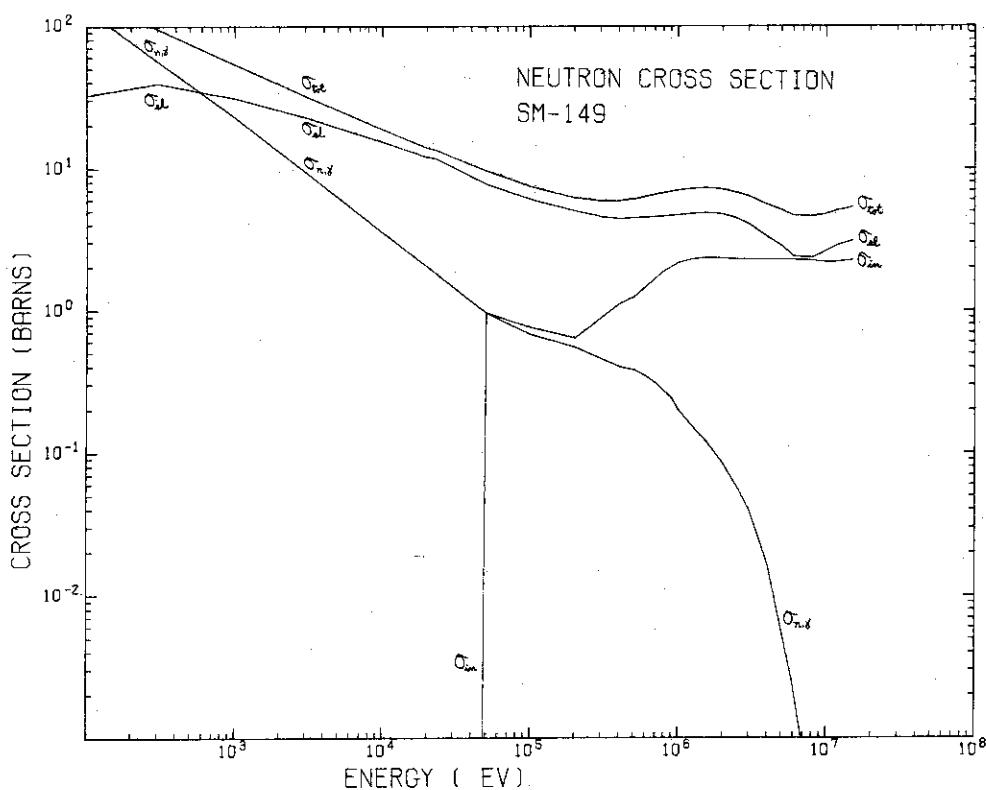


Fig A · 3(c)-25

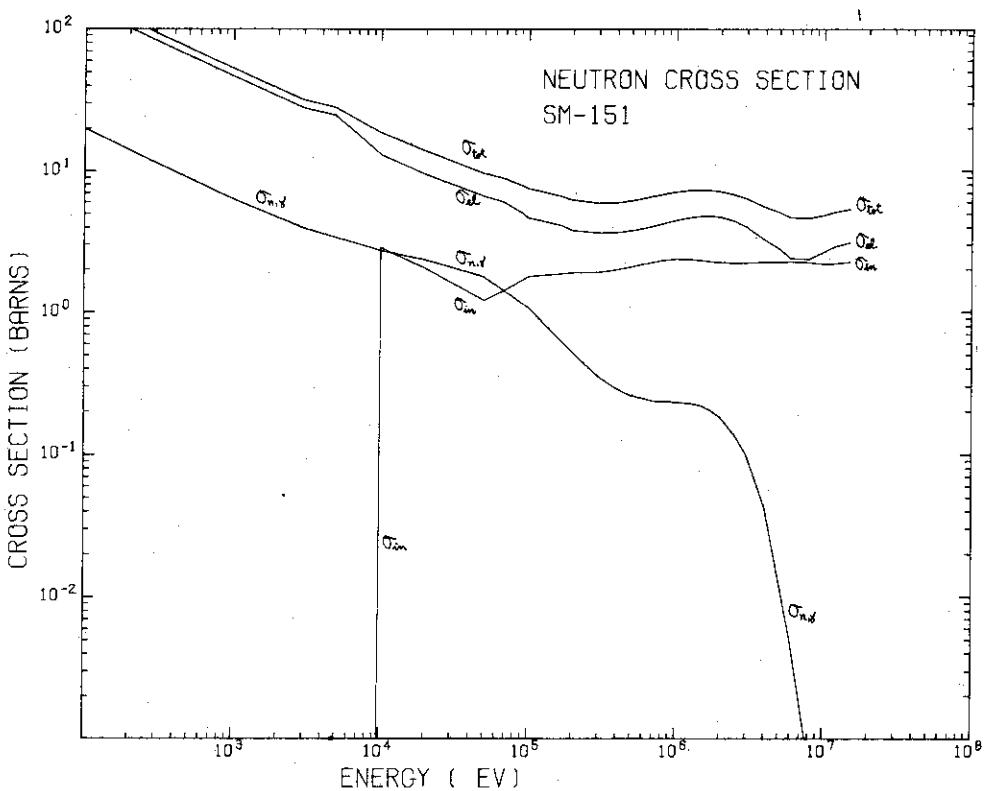


Fig A · 3(c)-26

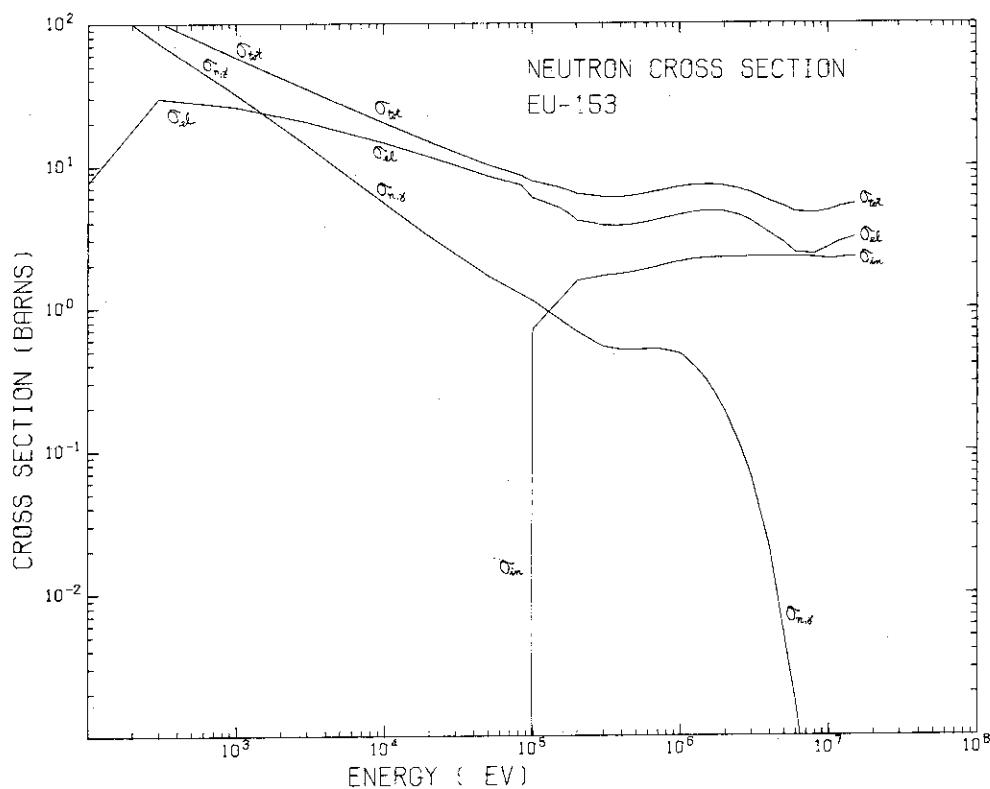


Fig A · 3(c)-27

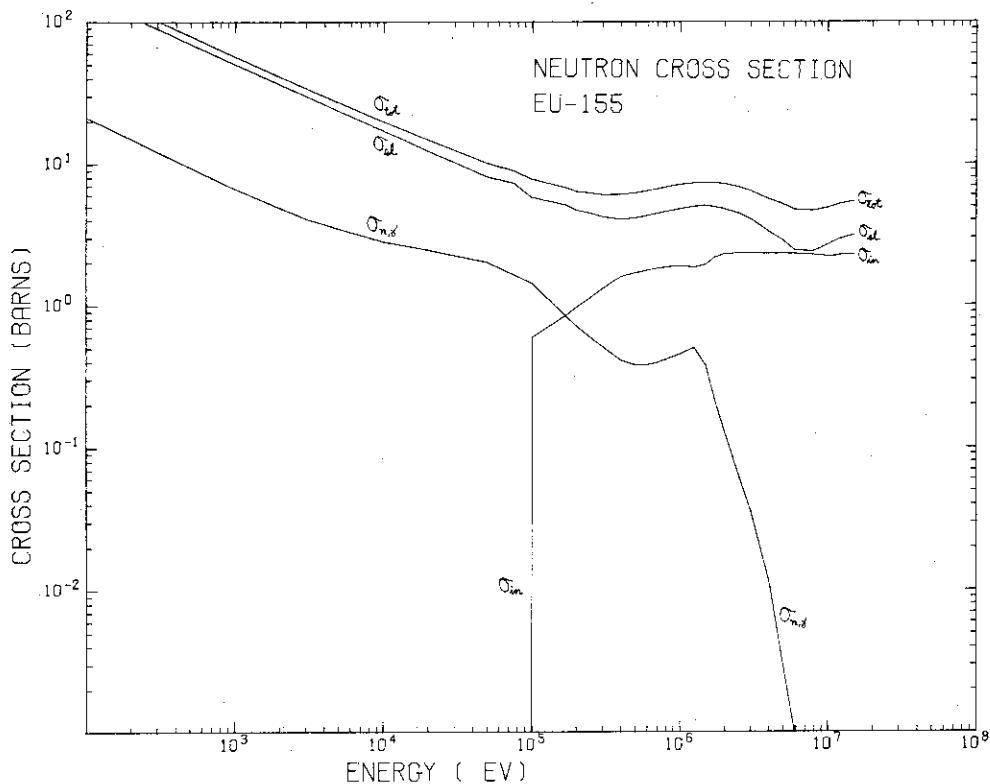


Fig A · 3(c)-28

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