ENDF/B PROCESSING CODES FOR THE RESONANCE REGION

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Availability of Computer Programs

The computer programs described in this report have been sent to the Argonne Code Center for distribution. For further information write or call

Argonne Code Center, Building 203 Room C-230
Argonne National Laboratory
9700 South Cass Avenue
Argonne, Illinois 60439

Phone: Area 312 739-7711 Extension 4366

Introduction

In this report we describe some six programs written for calculating point-wise cross-sections in the resolved and unresolved resonance region. These programs have been written specifically to read in the resonance parameters in the ENDF/B files. However, the smooth cross-sections from File 3 have to be added to the output of these programs to obtain the final cross-section.

Out of the six codes described in this report, the first four calculate the cross-sections in the resolved resonance region and the last two in the unresolved resonance region. The first program SIGPLOT calculates cross-sections for scattering, capture and fission using the single level Breit-Wigner parameters of ENDF/B Version I data. It also calculates multilevel scattering cross-sections. The cross-sections may be Doppler broadened if necessary. The second program SIGMA2 is essentially a modified version of SIGPLOT written for ENDF/B Version II data. The third program RAMP1 calculates scattering, capture and fission cross-sections using the Reich-Moore approximation, with or without Doppler broadening. The next program ADLER calculates cross-sections from the Adler-Adler parameters. Doppler broadening is done using the ψ and χ functions. AVRAGE3 and AVRAGE4 calculate cross-sections in the unresolved region using energy independent parameters and energy dependent parameters of ENDF/B Version II respectively. Width-fluctuation corrections are applied by numerical integration. Also, there is no provision made for allowing any inelastic effects in AVRAGE3 whereas they are taken into account in the latter program. After describing the programs, we have given the program listings with sample input data and

results of the test problems.

The main purpose of writing these codes has been to have a set of codes which (i) would serve as a standard reference set against which the results of other codes could be compared and (ii) could be used in neutron cross-sections evaluation and (iii) from which automated plots of cross-sections could be obtained for author proofs. As such, every effort has been made to obtain accurate results from the codes avoiding the usual computer time-saving approximations such as taking only a small number of resonances in a particular energy region. Also, these codes have been checked against existing codes to trace down any errors of programming. However, the author would appreciate it if the users could communicate any errors they might find in using these codes.

My grateful thanks are due to D. E. Cullen for writing the subroutines used in calculating the Doppler broadened cross sections by the trapezoidal rule I have also benefited from useful discussions with M. S. Moore.

Copies of these programs have been sent to the Argonne Code Center. (See Availability of Computer Codes)

Any further details regarding these programs may be obtained from the author at the National Neutron Cross Section Center.

Description of the Programs

PROGRAM SIGPLOT

This is a program to calculate scattering, capture, fission, and total cross sections from resonance parameters of Version I data from File 2 of ENDF/B. Provision is also made to allow for level-level interference effects in the scattering cross section. The formulae used are essentially the same as given in the report of Gregson, et al.,[1] but are modified to include fission. Modified versions of the three subroutines, ORDER, FACTS, and SIGMA, described in this report are used in the current program. Further details of thes formulae are given in the Data Formats and Procedures Manual[2].

Formulae:

1. Elastic Scattering

$$\sigma_{nn}^{\ell}(m) = (2\ell+1)\frac{4\pi}{k_m^2}\sin^2\varphi_\ell + \frac{\pi}{k_m^2}\sum_J g_J \sum_{r=1}^{N_{res}^{(\ell,J)}} \frac{\Gamma_{nr}^2\cos 2\varphi - 2\Gamma_{nr}(\Gamma_{\gamma r}+\Gamma_{fr})\sin^2\varphi_\ell}{(E-E_r')^2 + \left(\frac{\Gamma_r}{2}\right)^2} + \frac{2(E-E_r')\Gamma_{nr}\sin 2\varphi_\ell}{(E-E_r')^2 + \left(\frac{\Gamma_r}{2}\right)^2} \quad (1)$$

2. Capture

$$\sigma_{n\gamma}^{\ell}(m) = \frac{\pi}{k_m^2} \sum_J g_J \sum_{r=1}^{N_{res}^{(\ell,J)}} \frac{\Gamma_{nr}\Gamma_{\gamma r}}{(E-E_r')^2 + \left(\frac{\Gamma_r}{2}\right)^2} \quad . \tag{2}$$

3. Fission

$$\sigma_{nf}^{\ell}(m) = \frac{\pi}{k_m^2} \sum_J g_J \sum_{r=1}^{N_{res}^{(\ell,J)}} \frac{\Gamma_{nr}\Gamma_{fr}}{(E-E_r')^2 + \left(\frac{\Gamma_r}{2}\right)^2} \quad . \tag{3}$$

4. Elastic Scattering with Level-Level Interference

In addition to the expression given in Eq. (1), we have the following level-level interference term:

$$\frac{\pi}{k_m^2} \sum_J g_J \sum_{r=2}^{N_{res}^{(\ell,J)}} \sum_{s=1}^{r-1} \frac{2\Gamma_{nr}\Gamma_{ns}\left[(E-E_r')(E-E_s') + \frac{\Gamma_r\Gamma_s}{4}\right]}{\left[(E-E_r')^2 + \left(\frac{\Gamma_r}{2}\right)^2\right]\left[(E-E_s')^2 + \left(\frac{\Gamma_s}{2}\right)^2\right]} , \tag{4}$$

where m is the m^{th} isotope,

$N_{res}(\ell,J)$ are the number of resonances for a given ℓ and J,

$$\Gamma_{nr}(E) = \frac{P_\ell(E)\Gamma_{nr}(|E_r|)}{P_\ell(|E_r|)},$$

$$\Gamma_r = \Gamma_{nr}(E) + \Gamma_{\gamma r} + \Gamma_{fr},$$

$$E_r' = E_r + \left[\frac{S_\ell(|E_r|)-S_\ell(E)}{2P_\ell(|E_r|)}\right]\Gamma_{nr}(|E_r|) \qquad (E \text{ in eV}),$$

$$k_m = 2.196771\times10^{-3}\left(\frac{AWR}{AWR+1.0}\right)\sqrt{E(eV)} \qquad (\text{barns})^{-1/2},$$

AWR = mass of the element in units of the neutron mass,

E = neutron energy in eV in the Laboratory System,

S_ℓ = shift factor,

P_ℓ = penetration factor,

φ_ℓ = phase shift,

ρ = ka,

a = channel radius.

Storage Capacity of the Program

1. Maximum number of isotopes: 10.
2. Maximum number of ℓ values per isotope per energy range: 5.
3. Maximum number of resonances over all isotope energy ranges and ℓ values: 500.
4. Total memory for the program: 37K octal.

5. Time: approximately 14 secs C.P. time/ 25 res/ isotope on the CDC-6600.

6. This program assumes that the resolved resonance parameters are given for one energy range which is the same for all isotopes.

Procedure:

1. After all the data for one element are read in, the resonance energies over all isotopes are arranged in increasing order.

2. For each pair of levels which lie within the limits of the energy range in the input data, a variable number (8 = 4 MM as it stands now) of energy points which lie between these two levels are generated, and the scattering, capture, fission, and total cross section are calculated and printed out for all the resonances of a given isotope as well as for all the isotopes of a given element. A finer mesh may be obtained by setting MM (card SIGP246) to a higher value.

3. To avoid having huge core storage, the cross sections are not stored in memory but are printed out as they are generated.

4. The resonances in each isotope are arranged in increasing order of ℓ and for a given increasing order of J before the cross sections are calculated.

5. For a given isotope, the measured resonance spins are, for example, 3 and 4. In File 2 the spins of some low energy resonances where they have been experimentally measured will have one of these two values. For the rest of the resonances where this data is lacking, the

spins would be given as 3.5. In such a case, in calculating the cross section with level-level interference, we let spin-3 resonances interfere with one another. Similarly, spin-4 resonances that interfere with each other are treated as a group. The rest of the resonances (spin 3.5) do not interfere among themselves unless this is indicated on the title card in Col. 65 (see p. 8).

6. To Doppler-broaden cross sections, we write the Doppler-broadened cross section as

$$\sigma_{\Delta}(E') = \frac{1}{\Delta\sqrt{\pi}} \int_{0}^{\infty} \sigma(E'') \; e^{-[(E'-E'')/\Delta]^2} \; dE'' \; , \qquad (5)$$

where

$$\Delta\,(\text{eV}) = 0.3177 \left(\frac{T^{o}_{eff}}{293.0}\right)^{1/2} \left(\frac{E'(\text{eV})}{\text{AWR}}\right)^{1/2}$$

T^{o}_{eff} = effective temperature in degrees Kelvin.

AWR = nuclear mass

The above expression is obtained as a good approximation for the more accurate expression for Doppler-broadened cross section (see Solbrig[3]) when $E/\Delta \gg 1$. It is known that this approximation is good except at very low energies where the more accurate expression has to be used. Therefore, in this program Doppler-broadening of the cross section is by-passed for neutron energies less than 0.025 eV. The above expression

can be written as

$$\sigma_{\Delta}(E') = \frac{1}{\sqrt{\pi}} \int_{-E'/\Delta}^{\infty} \sigma(E' + x \cdot \Delta) e^{-x^2} dx , \tag{6}$$

where since E'/Δ is large, the integral is written as

$$\sigma_{\Delta}(E') = \frac{1}{\sqrt{\pi}} \int_{-\infty}^{+\infty} \sigma(E' + x \cdot \Delta) e^{-x^2} dx . \tag{7}$$

A. Gauss-Hermite Quadrature

This integral can be evaluated using a 9-point Gauss-Hermite quadrature formula, provided the structure in the cross section is not small compared with the Doppler width Δ. Comparison of a test case which is Doppler broadened using ψ and χ functions, the trapezoidal rule, and Gauss-Hermite quadrature formula gives accurate results, provided the width of the resonances $\Gamma \geq 5\Delta$. If this condition is not satisfied, we have recourse to using the trapezoidal rule for evaluating the integral as described below. In most of the cases we use the quadrature formula for calculating the integral, as it has been found that the trapezoidal rule method requires a large amount of computer time. However, the trapezoidal method should be used if the resonances are very narrow and/or are very closely spaced. This may be done by setting all FLAG(I) = 1 in the subroutine SIEVE.

B. Trapezoidal Method

The above integrals can also be evaluated numerically by using the

trapezoidal rule. To start with, a certain number of pivot points (NTAB which is an odd integer) equal to, say, 11 are specified at each energy E' where we wish to evaluate the Doppler-broadened cross section. Pivot points are then specified at eleven energy values given by $E'' = E'$ and $E'' = E' \pm \Delta \ldots . E' \pm 5\Delta$. The cross section to be Doppler-broadened is explicitly evaluated at each pivot point at every iteration. The integral will give negligible contribution beyond this energy interval due to the $e^{-(E'-E'')^2/\Delta^2}$ factor. If, however, E' is very small so that the energy at one of the above pivot points is less than or equal to zero, we set $E'' = 10^{-3}$ eV as the lowest energy and set the energy of the pivot points at $E'' = 10^{-3} + \Delta \ldots ., 10^{-3} + 10\Delta$. In addition, we have to specify an ERRØR (say of the order of 10^{-4}). The above integral is then evaluated at these points, and if the relative value in each subinterval is less than ERRØR/(NTAB-1), the program assumes that the integral has converged in that interval; if not, at every iteration the number of steps is doubled until the integral converges. This method has been checked against results obtained by using ψ and χ functions in test cases and found to converge rapidly.

Use of these two numerical methods to evaluate the Doppler-broadened cross sections enables us to treat resonances due to higher ℓ-values where expressions for the Doppler-broadened cross sections in terms of the ψ and χ functions become very involved.

Input Data

The first card of the input is a TITLE card with the format (7A4,2X,I5,F5.1, 2I5, E10.4, I5). One can punch an appropriate title in Cols. 1-28. If Doppler-broadened cross sections are desired, punch 1 in Col. 35, or else punch 0. In Cols. 36-40 give the effective temperature T_{eff} in degrees Kelvin, and in Cols. 41-45 punch NTAB, which is eual to the odd number of pivot points for the integration for Doppler-broadening; NTAB > 13 seems highly unlikely. In Cols. 46-50 punch an integer between 1 and 6 which specifies the particular cross section to be Doppler-broadened. The following list indicates these:

1 - scattering cross section with no level-level interference

2 - capture cross section with no level-level interference

3 - fission cross section with no level-level interference

4 - sum of the above three

5 - scattering cross section with level-level interference

6 - sum of 5, 2, and 3.

In Cols. 51-60 punch ERROR, which has been described above. If level-level interference in the scattering cross sections among those resonances which are assigned an average spin is desired, punch 1 in Col. 65, or else punch 0. The rest of the data cards are from ENDF/B File 2 beginning with the HEAD Card and these give the resonance parameters. These are described in the Data Formats and Procedures Manual[2].

REACTOR CODE ABSTRACT

1. Name of Code: SIGPLØT.

2. Computer for which Code is designed: CDC-6600.

3. Nature of problem solved: This code calculates the scattering, capture, fission, and total cross sections from resolved resonance parameter data. Scattering cross sections may be calculated with or without level-level interference. Provision is also made to numerically Doppler-broaden any of the cross sections.

4. Method of solution: Multi-level Breit-Wigner formula. Details of formulae to be found in Gregson, et al.[1]

5. Restrictions on the complexity of the problem: This program can handle resonance data up to a maximum of 10 different isotopes with a total number of 500 resonances and an ℓ value not exceeding 5. It further assumes that the resolved resonance parameters are given for one energy range which is the same for all the isotopes of an element. The mesh points at which the cross sections are calculated can be varied. Since the calculated data are not stored, an increase in the number of mesh points does not conflict with any storage requirements.

6. Typical running time: Calculations of the cross sections of monoisotopic manganese from its resonance data with 27 resonances, with 20 mesh points between the positive energy resonance, takes 14 secs of central processor time on the CDC-6600.

7. Unusual features of the program:

   a) In calculating scattering cross sections with level-level interference, resonances are grouped according to their spins for the same ℓ value. Thus for s-wave resonances, for example, the spins are 3 and 4. It is possible that there are a number of resonances whose spins have not been measured, and these are

given an average spin of 3.5. The program normally calculates scattering cross sections with level-level interference among the spin-3 group and the spin-4 group. Contributions of the spin-3.5 resonances are calculated as a sum of single-level Breit-Wigner terms. If, however, it is desired to include the level-level interference terms among these resonances, this may be indicated on the control card.

b) The method of numerical integration used to Doppler-broaden cross sections is very general and is designed to take care of situations where the fine structure of the cross section is rapidly varying.

8. Related auxiliary programs: This program has been patterned after the MLBW program[1] with certain corrections and changes in the subroutines ORDER, FACTS, and SIGMA.

9. References: K. Gregson, M. F. James, and D. S. Norton, "MLBW - A Multi-level Breit-Wigner Computer Program," U.K. Atomic Energy Establishment Report AEEW-M517 (1965).

10. Machine requirements: This needs a 37k octal memory.

11. Programming language: FORTRAN IV.

12. Operating system or monitor: Brookhaven National Laboratory version of CDC Scope 2.0 operating system.

13. Other programming or operating information: None.

14. Name and establishment: M. R. Bhat and D. Cullen, National Neutron Cross Section Center, Brookhaven National Laboratory, Upton, N.Y.

15. Material available: Fortran deck with sample output.

16. Category:

PROGRAM SIGMA2

This program is a modified version of SIGPLOT described in the preceding pages. The modifications enable it to handle ENDF/B Version II data. These modifications are described in the Data Formats and Procedures Manual[2] in great detail and are briefly the following:

(1) provision is made to give the individual isotopic masses AWRI

(2) channel radius "a" (in units of 10^{-12} cm) and defined by

$$a = \left[1.23(AWRI * 1.008665)^{1/3} + 0.8\right] \times 10^{-1}$$

is used to calculate the penetrabilities P_ℓ (ka) and the shift factors S_ℓ(ka) whereas the effective scattering radius $\hat{a}$ is used to calculate $\varphi_\ell(k\hat{a})$, the phase shift.

For details regarding the input data, Doppler broadening and other details of the program please see the write-up on SIGPLOT (p. 12) as they are common to the two programs.

PROGRAM RAMP1

Program RAMP1 (Reich And Moore Program Version 1) calculates scattering, capture, fission and total cross sections in the resolved resonance region using the Reich-Moore formalism[4]. The resonance parameters are assumed to be in the ENDF/B Version-II data format[2]. The cross sections may also be Doppler broadened if so desired.

Formulae:

The cross section for a neutron reaction with the exit channel c is:

$$\sigma_{nc} = \pi \lambda\!\!\!^{-}_n^2 \sum_J g_J \left| \delta_{nc} - U^J_{nc} \right|^2 \qquad (1)$$

where $\lambda\!\!\!^{-}_n$ is the reduced neutron wave length; g_J is the statistical weight factor for resonances of spin J and U^J_{nc} is the collision matrix.

In the Reich-Moore approximation, the collision matrix is expressed in terms of a matrix (I-K), with dimensions (m+1)x(m+1) where m is the number of fission channels used in the cross section analysis; (m=2 in the ENDF/B format) and it is assumed that there is only one neutron channel (though there may be two channel spins for p-wave neutrons). Thus we define,

$$(I-K)_{cc'} = \delta_{cc'} - \frac{i}{2} \sum_\lambda \frac{\Gamma_{\lambda c}^{1/2} \Gamma_{\lambda c'}^{1/2}}{E_\lambda - E - \frac{i}{2}\Gamma_{\lambda\gamma}} \qquad (2)$$

where E_λ is the resonance energy and $\Gamma_{\lambda\gamma}$ the corresponding capture width of the λ-th resonance and $\Gamma_{\lambda c}$ and $\Gamma_{\lambda c'}$ are the partial widths corresonding to the channels c and c'. Here it is also further assumed that the shift factor Δ_λ is zero. The collision matrix U^J_{nc} can be expressed in terms

of the matrix defined in equation (2) as

$$U^J_{nc} = e^{-i(\varphi_n+\varphi_c)} \left[2(I-K)^{-1}_{nc} - \delta_{nc}\right] \tag{3}$$

where φ_n and φ_c are the hard-sphere phase-shifts. The different cross sections can now be written as

$$\begin{aligned}\sigma_{Total} &= \sum_J \sigma^J_{nT} = 2\pi \lambda^2_n \sum_J g_J \mathrm{Re}\,(1-U^J_{nn}) \\ &= 2\pi \lambda^2_n \sum_J g_J \left[(1-\cos 2\varphi^{\ell}_n) + 2\mathrm{Re}\ (e^{-2i\varphi^{\ell}_n} \rho_{nn}) \right]\end{aligned} \tag{4}$$

$$\begin{aligned}\sigma_{Fission} &= \sum_J \sigma^J_{nf} = \pi \lambda^2_n \sum_J g_J \left(\left| U^J_{nf_1} \right|^2 + \left| U^J_{nf_2} \right|^2 \right) \\ &= 4\pi \lambda^2_n \sum_J g_J \left(\left| \rho^J_{nf_1} \right|^2 + \left| \rho^J_{nf_2} \right|^2 \right)\end{aligned} \tag{5}$$

$$\begin{aligned}\sigma_{Scattering} &= \sum_J \sigma^J_{nn} = \pi \lambda^2_n \sum_J g_J \left| 1 - U^J_{nn} \right|^2 \\ &= \pi \lambda^2_n \sum_J g_J \left[2(1 - \cos 2\varphi^{\ell}_n) + 4\mathrm{Re}\left(e^{-2i\varphi^{\ell}_n} \rho^J_{nn}\right) \right. \\ &\qquad \left. - 4\mathrm{Re}\ (\rho^J_{nn}) + 4 \left| \rho^J_{nn} \right|^2 \right]\end{aligned} \tag{6}$$

$$\sigma_{capture} = 4\pi \lambda^2_n \sum_J g_J \sum_{a,b} (I-K)^{-1}_{na}\ (I-K)^{-1}_{nb}{}^{*} \mathrm{Re}\left[(I-K)_{ab} - \delta_{ab}\right] \tag{7}$$

where a,b = 1, 2, 3, and 1 = neutron channel and 2, 3 are fission channels.

The total, fission and capture cross-sections are obtained by direct calculation and the scattering cross-section is obtained by subtraction form these.

In the above expressions the matrix ρ_{nc} is defined as

$$\rho_{nc} = \delta_{nc} - (I - K)^{-1}_{nc}.$$

In addition we define the following:

$$\Gamma_{\lambda n}(E) = \frac{P_\ell(E)\ \Gamma_{\lambda n}(|E_\lambda|)}{P_\ell(|E_\lambda|)}$$

$$k_n = \frac{1}{\lambda_n} = 2.196771 \times 10^{-3} \left(\frac{AWRI}{AWRI+1.0}\right)\sqrt{E(eV)}$$

where AWRI is the isotopic mass of the I-th isotope in units of the neutron mass.

E = the neutron energy in eV in the laboratory system.

P_ℓ = penetration factor for angular momentum ℓ.

φ_ℓ = phase shift factor " " " ".

where,

$$\varphi_0 = k\hat{a}$$

$$\varphi_1 = k\hat{a} - \tan^{-1}(k\hat{a})$$

$$\varphi_2 = k\hat{a} - \tan^{-1}\left(\frac{3k\hat{a}}{3-k^2\hat{a}^2}\right) \quad \text{etc.}$$

$\hat{a}$ = effective scattering radius.

We use a channel radius $a = (1.23(AWRI * 1.008665)^{1/3} + 0.8) \times 10^{-1}$ in units of 10^{-12} cm to calculate the penetration factor and the effective scattering radius "$\hat{a}$" as determined from a fit of experimental data to calculate the scattering cross section.

Storage Capacity of the Program

1. Maximum number of isotopes: 10.

2. Maximum number of ℓ values per isotope per energy range: 5.

3. Maximum number of resonances over all isotope energy ranges and ℓ values: 500.

4. Total memory for the program: 40 K octal.

5. Time: approximately 11 secs/100 energy points for a nucleus with 4 isotopes and 294 s- and p-wave resonances.

6. This program assumes that the resolved resonance parameters are given for one energy range which is the same for all isotopes.

Procedure:

1. After all the data for one element are read in, the resonance energies over all isotopes are arranged in increasing order.

2. For each pair of levels which lie within the limits of the energy range in the input data, a variable number of energy points (4 MM = 8 as it stands now) which lie between these two levels are generated, and the scattering, capture, fission, and total cross section are calculated and printed out for all the resonances of a given isotope as well as for all the isotopes of a given element. One can get a finer mesh by setting MM (card RMP1228) to a higher value.

3. To avoid having huge core storage, the cross sections are not stored in memory but are printed out as they are generated.

4. The resonances in each isotope are arranged in increasing order of ℓ and for a given increasing order of J before the cross sections are calculated.

5. To Doppler-broaden cross sections, the same procedure using Grauss-Hermite Quadrature or the Trapezoidal Method as described in SIGPLOT (p.10) is used.

Input Data

The first card of the input is a TITLE card with the format (7A4,2X,I5,F.1, 2I5, E10.4, I5). One can punch an appropriate title in Cols. 1-28. If Doppler-broadened cross sections are desired, punch 1 in Col. 35, or else punch 0. In Cols. 36-40 give the effective temperature T_{eff} in degrees Kelvin, and in Cols. 41-45 punch NTAB, which is equal to the odd number of pivot points for the integration for Doppler- broadening; NTAB > 13 seems highly unlikely. In Cols. 46-50 punch an integer between 1 and 4 which specifies the particular cross section to be Doppler-broadened. The following list indicates these:

1 - scattering cross section

2 - capture cross section

3 - fission cross section

4 - total cross section.

In Cols. 51-60 punch ERROR, which has been described above. The rest of the data cards are from ENDF/B File 2 beginning with the HEAD Card and these give the resonance parameters[2].

REACTOR CODE ABSTRACT

1. Name of Code: RAMP1
2. Computer for which code is designed: CDC-6600
3. Nature of problem solved: This code calculates scattering, capture, fission and total cross sections from Reich-Moore resolved resonance parameters. Cross sections may be Doppler broadened if so desired.
4. Method of solution: Reich-Moore approximation. Details may be found in the reference given.
5. Restrictions on the complexity of the problem: This program can handle resonance data up to a maximum of 10 different isotopes with a total number of 500 resonances and an ℓ value not exceeding 5. The mesh points at which the cross sections are calculated can be varied. Further, since the calculated data are not stored, an increase in the number of mesh points does not conflict with any storage requirements.
6. Typical running time: Calculations of 4 isotopes involving a total of 294 s and p-wave resonances took 11 sec. of central processor time per 100 energy points on the CDC-6600.
7. Unusual features of the program: The Doppler broadening is done using numerical methods and can handle p-wave and resonances corresponding to higher partial waves.
8. Related auxiliary programs: None
9. References: C. W. Reich and M. S. Moore, Phys. Rev. 111, 929, 1958.
10. Machine Requirements: This program needs 40K octal memory.
11. Programming language: FORTRAN IV

13. Operating System or monitor: Brookhaven National Laboratory version of CDC Scope 3.0 operating system.

14. Name and establishment: M. R. Bhat, National Neutron Cross Section Center, Brookhaven National Laboratory, Upton, N. Y. 11973.

15. Material available: FORTRAN deck with sample output.

16. Category:

PROGRAM ADLER

This is a program to calculate total, capture or fission cross-sections according to the Adler-Adler formalism using the corresponding parameters from File 2 of ENDF/B Version II data.

Formulae

The Adler-Adler formulae have been discussed in the reports given in the references[5,6]. The formulae are:

$$\sigma^{(x)}(E) = \frac{2C}{E}(1 - \cos\omega) + \frac{C}{\sqrt{E}}\sum_k \frac{\nu_k(G_k^{(x)}\cos\omega + H_k^{(x)}\sin\omega) + (\mu_k - E)(H_k^{(x)}\cos\omega - G_k^{(x)}\sin\omega)}{(\mu_k - E)^2 + \nu_k^2}$$

$$+ \frac{C}{\sqrt{E}}\left(A_1^{(x)} + \frac{A_2^{(x)}}{E} + \frac{A_3^{(x)}}{E^2} + \frac{A_4^{(x)}}{E^3} + B_1^{(x)}E + B_2^{(x)}E^2\right) \qquad (1)$$

and $B.G = \frac{C}{\sqrt{E}}\left(A_1^{(x)} + \frac{A_2^{(x)}}{E} + \frac{A_3^{(x)}}{E^2} + \frac{A_4^{(x)}}{E^3} + B_1^{(x)}E + B_2^{(x)}E^2\right)$;

where $\frac{C}{E} = \pi\lambda^2$; where $\frac{1}{\lambda} = k = 2.196771 \times 10^{-3} \times \left(\frac{AWRI}{AWRI+1.0}\right)\sqrt{E(eV)}$.

where k is the wave number of the incident neutron in the center-of-mass system and AWRI is the isotopic mass in units of the neutron mass.

$\frac{2C}{E}(1-\cos\omega)$ = potential scattering cross section; this term is non-zero only for scattering and total cross sections.

Procedure (con't)

(3) Cross-sections are not stored in memory so that an increase in mesh points does not conflict with any memory requirements.

(4) Only s-wave resonances are handled by the program.

(5) The Doppler broadened cross-section is written as:

$$\sigma_{\Delta}(E) = \frac{1}{\Delta\sqrt{\pi}} \int_{0}^{\infty} \sigma(E') e^{\frac{-(E-E')^2}{\Delta^2}} dE' \qquad (2)$$

where $\Delta(eV) = 0.3177 \left(\frac{T^{\circ}_{eff}}{293.0}\right)^{\frac{1}{2}} \left(\frac{E(eV)}{AWRI}\right)^{\frac{1}{2}}$

where T°_{eff} = effective temperature in degrees Kelvin

AWRI = mass of the isotope. This expression is quite good except for resonances of very small energies.[7] We use the real and imaginary parts of the complex probability integral which are proportional to the Ψ and Φ functions to obtain expressions for Doppler broadened cross-sections.

We define

$$U = \mathrm{Im}\left(\frac{i}{\pi} \int_{-\infty}^{+\infty} \frac{e^{-t^2}}{z-t}\, dt\right) \quad ; \quad V = \mathrm{Re}\left(\frac{i}{\pi} \int_{-\infty}^{+\infty} \frac{e^{-t^2}}{z-t}\, dt\right) \qquad (3)$$

where $z = \xi + i\eta$, ξ and η real. Further,

$$\Psi(s,\theta) = \tfrac{1}{2}\sqrt{\frac{\pi}{\theta}}\, U(\xi,\eta) = \frac{1}{(4\pi\theta)^{\frac{1}{2}}} \int_{-\infty}^{+\infty} \frac{e^{-(s-r)^2/4\theta}}{1+r^2} dr$$

$$\text{and } \Phi(s,\theta) = \tfrac{1}{2}\sqrt{\frac{\pi}{\theta}}\, V(\xi,\eta) = \frac{1}{(4\pi\theta)^{\frac{1}{2}}} \int_{-\infty}^{+\infty} \frac{e^{-(s-r)^2/4\theta}}{1+r^2}\, r\, dr$$

where $\eta = \frac{1}{2\sqrt{\theta}}$ and $\xi = s\eta$. If we further set $\xi = \frac{\mu - E}{\Delta}$ and $\eta = \frac{\nu}{\Delta}$,

$\rho = 2k\hat{a}$ Where $\hat{a}$ corresponds to the effective scattering radius in units of 10^{-12} cm;

$= 2WN\sqrt{E(eV)}$ and $WN = 2.196771\left(\frac{AWRI}{AWRI + 1.0}\right) \times 10^{-3} \times \hat{a}$,

$A_1^{(x)}$, $A_2^{(x)}$, $A_3^{(x)}$, $A_4^{(x)}$ and $B_1^{(x)}$, $B_2^{(x)}$ are background parameters which give contributions due to "tails" of resonances lying outside of the energy range under consideration. They are associated with the type of reaction "x".

$G_k^{(x)}$, $H_k^{(x)}$ Are Adler-Adler parameters, characteristic of the k-th resonance and the type of reaction indicated by "x".

Procedure

(1) After all the data for one element are read in, the resonance energies of all the isotopes are arranged in increasing order.

(2) For each pair of resonances which lie within the limits of the energy range in the input data, a variable number of energy points (20 = 4 MM as it stands now) which lie between these two resonances are generated, and the total, capture and fission cross sections are calculated and printed out. This is done for all the resonances in an element. A finer mesh may be obtained by setting MM (card ADLR278) to a higher value.

we obtain the Doppler broadened cross section as

$$\sigma_{\Delta}^{(x)}(E) = \frac{2C}{E}(1-\cos\omega) + \frac{C\sqrt{\pi}}{\Delta}\sum_{k}\frac{U_k^{(x)}}{E^{\frac{1}{2}}}\left(G_k^{(x)}\cos\omega + H_k^{(x)}\sin\omega\right)$$

$$+ \frac{C\sqrt{\pi}}{\Delta}\sum_{k}\frac{V_k^{(x)}}{E^{\frac{1}{2}}}\left(H_k^{(x)}\cos\omega - G_k^{(x)}\sin\omega\right) \qquad (4)$$

The potential scattering term (non-zero only for scattering and total cross-sections) and the background terms are not Doppler broadened, as they are slowly varying and not affected by Doppler broadening. The functions $U_k^{(x)}$ and $V_k^{(x)}$ are characteristic of the k-th resonance of the type of cross-section "x" , and its parameters are evaluated using a subroutine-PFCN[8].

Input Data

First Data Card: Format (7A4,2X, I5, F5.1)

Reads in TITLE(1), ... , TITLE(7), IDPL, TEFF

TITLE(1), ..., TITLE(7), = any suitable title for the program.

IDPL = 1 if Doppler broadened cross-sections are desired or else = 0

TEFF = Effective temperature of the sample in degrees kelvin.

Rest of the Data Cards: Follow the ENDF/B File 2 format for Adler-Adler parameters. This is described in detail in Reference 2.

REACTOR CODE ABSTRACT

1. Name of Code: ADLER

2. Computer for which code is designed: CDC-6600

3. Nature of problem solved: This code calculates total, capture and fission cross-sections from the corresponding Adler-Adler parameters in the ENDF/B File 2 and also Doppler broadens cross-sections.

4. Method of solution: Adler-Adler formalism. Details of formulae are to be found in the report given in references.

5. Restrictions on the complexity of the problem: This program can handle resonance data up to a maximum of 10 isotopes with a total number of 500 resonances. It further assumes that the resolved resonance parameters are given for one energy range which is the same for all the isotopes of an element. The mesh points at which the cross-sections are calculated can be varied. Since the calculated data are not stored, an increase in the number of mesh points does not conflict with any storage requirement.

6. Typical running time: Calculations of cross-sections of one isotope with 37 resonances and 20 mesh points between resonances takes:
   (a) without Doppler broadening, 21 secs
   (b) with Doppler broadening, 209 secs.

7. Unusual features of the program: None

8. Related auxiliary program: None

9. References: D. B. Adler and F. T. Adler, Analysis of Neutron Resonances in Fissile Elements: Programs CØDILLI, CURVEPLØT and SIGMA, Report COO-1546-3 (Sept. 1966), Dept. of Physics, University of Illinois, Urbana, Illinois.

10. Machine requirements: This needs a 37K octal memory.

11. Programming language: FORTRAN IV

12. Operating system or monitor: Brookhaven National Laboratory version of CDC Scope 3 operating system.

13. Other programming or operating information: None

14. Name and establishment: M. R. Bhat, National Neutron Cross-Section Center, Brookhaven National Laboratory, Upton, New York.

15. Material available: FORTRAN Deck with sample output.

16. Category:

PROGRAM AVRAGE3

This is a program to calculate scattering, capture, and fission cross sections in the unresolved resonance region from the energy independent parameters given in ENDF/B, File 2.

Method

The method follows the paper of Lane and Lynn[9] and we write the average scattering, fission, and capture cross section respectively as

$$\left\langle \sigma_{n,n} \right\rangle = \frac{K}{E} \sum_J \frac{g_J}{\langle D_J \rangle} \left[\left\langle \frac{\Gamma_n \Gamma_n}{\Gamma_n+\Gamma_f+\Gamma_\gamma} \right\rangle - 2\Gamma_n \sin^2 \varphi_\ell \right] + \sigma_p \quad (1)$$

$$\left\langle \sigma_{n,f} \right\rangle = \frac{K}{E} \sum_J \frac{g_J}{\langle D_J \rangle} \left\langle \frac{\Gamma_n \Gamma_f}{\Gamma_n+\Gamma_f+\Gamma_\gamma} \right\rangle , \quad (2)$$

and

$$\left\langle \sigma_{n,\gamma} \right\rangle = \frac{K}{E} \sum_J \frac{g_J}{\langle D_J \rangle} \left\langle \frac{\Gamma_n \Gamma_\gamma}{\Gamma_n+\Gamma_f+\Gamma_\gamma} \right\rangle , \quad (3)$$

where $K = (2\pi^2/k^2)E(ev)$, where $k = \frac{1}{\lambda} = 2.196771 \times 10^{-3} * \left(\frac{AWRI}{AWRI+1.0}\right)\sqrt{E}$ and

AWRI is the isotopic mass,

E = neutron energy in eV,

$g_J = \frac{(2J+1)}{2(2I+1)}$, where I is the target nucleus spin and J is the compound nucleus spin,

$\langle D_J \rangle$ = mean level spacing in eV for spin J resonances,

$\sigma_p = \sum_\ell \sigma_{p\ell}$ = potential scattering cross section,

$\sigma_{p\ell} = 4\pi(2\ell+1)\frac{\sin^2 \varphi_\ell}{k^2}$ where ℓ is the angular momentum and

$\varphi_0 = k\hat{a}$ where $\hat{a}$ is the scattering radius (A)

$\varphi_1 = k\hat{a} - \tan^{-1}(k\hat{a})$ and etc.

and the rest of the quantities are different partial widths in eV. The quantities in equation (1) refer to one particular ℓ-value. The brackets indicate averaging over the neutron and fission width fluctuations assumed to follow a χ^2 distribution of different degrees of freedom as given in the ENDF/B data. We would like to point here that the fluctuation correction factors $R_{n\ell,J}$, $R_{\gamma\ell,J}$, or $R_{f\ell,J}$ are not calculated separately as the fluctuation corrections are applied by direct averaging as indicated in equations 1-3. The summation is over the different spin states. The averaging is done by the method of Greebler and Hutchins[10] and corresponds to evaluating the double integrals on a 10x10 grid, and ν can vary from 1 to 4. The gamma width Γ_γ is assumed to follow a δ-function type of distribution corresponding to a large number degrees of freedom in the χ^2 distribution.

Incidentally, we note here that this program (1) takes into account only s- and p-wave contributions to the cross sections and (2) does not take into account inelastic scattering. This program uses the channel radius $a = (1.23 \times (AWRI \times 1.008668)^{1/3} + 0.8) \times 10^{-1}$ in units of 10^{-12} cm to calculate nuclear penetrabilities.

This program needs 21K octal memory for execution.

The data input is explained in great detail in the FORTRAN listing of the program and follows the ENDF/B format except for the first data card which is the title card.

Title Card Format (I10, 7A4, 2X, 3E10.4)

This reads in IRUN, RUN(1), ·····, RUN(7), E0, EN, ESTEP.

IRUN = Any run number. If this is zero the program exists, otherwise this card indicates the beginning of a new calculation and one can stack any number of these one behind another.

RUN(1), ..., RUN(7) = Any alphanumeric information.

EO = Beginning energy for calculations in eV.

EN = Ending energy for calculations in eV.

ESTEP = Step interval in eV for calculations in eV.

This information is needed only for non-fissile nuclei.

REACTOR CODE ABSTRACT

1. Name of Code: AVRAGE3

2. Computer for which Code is designed: CDC-6600

3. Nature of problem solved: This Code calculates average scattering, capture, and fission cross sections from s- and p-wave data of the unresolved parameters of File 2 of ENDF/B.

4. Method of calculation: Theory of average cross section due to Lane and Lynn.[9]

5. Restrictions on the complexity of the problem: This program calculates average cross sections up to 100 energy values in the unresolved region. It does not allow for inelastic scattering and calculates only s- and p-wave contributions. Maximum $\nu = 4$.

6. Typical running time: Test run calculating s- and p-wave contributions to average scattering, capture, and fission cross sections of Pu-239 at 16 energy points and s- and p-wave contributions to average scattering at capture cross section of U-238 at 100 energy points took 5 secs of central processor time on the CDC-6600.

7. Unusual feature of the program: This program can allow for different degrees of freedom for fission width distribution of resonances of different spins.

8. Related auxiliary programs: None.

9. References: A. M. Lane and J. E. Lynn, Proc. Phys. Soc. A70, 557 (1957).

10. Machine requirements: Needs 21K octal memory.

11. Programming language: FORTRAN IV.

12. Operating system or monitor: Brookhaven National Laboratory version of CDC Scope 3.0 operating system.

13. Other programming or operating information: None.

14. Name and establishment: M. R. Bhat, National Neutron Cross Section Center, Brookhaven National Laboratory, Upton, New York.

15. Material available: Fortran deck with sample output.

16. Category:

PROGRAM AVRAGE4

This is a program to calculate scattering capture, and fission cross sections in the unresolved resonance region, with the ENDF/B Version II data for the unresolved parameters of File 2 which gives the average neutron, gamma and fission widths and widths for any competing inelastic processes as a function of energy.

Method

The method follows the paper of Lane and Lynn[9] and we write the average scattering, fission, and capture corss section respectively as

$$\langle\sigma_n\rangle = \frac{K}{E}\sum_J \frac{g_J}{\langle D_J\rangle}\left[\left\langle\frac{\Gamma_n\Gamma_n}{\Gamma_n+\Gamma_f+\Gamma_\gamma+\Gamma_x}\right\rangle - 2\,\Gamma_n \sin^2\varphi_\ell\right] + \sigma_p \qquad (1)$$

$$\langle\sigma_f\rangle = \frac{K}{E}\sum_J \frac{g_J}{\langle D_J\rangle}\left\langle\frac{\Gamma_n\Gamma_f}{\Gamma_n+\Gamma_f+\Gamma_\gamma+\Gamma_x}\right\rangle , \qquad (2)$$

and

$$\langle\sigma_\gamma\rangle = \frac{K}{E}\sum_J \frac{g_J}{\langle D_J\rangle}\left\langle\frac{\Gamma_n\Gamma_\gamma}{\Gamma_n+\Gamma_f+\Gamma_\gamma+\Gamma_x}\right\rangle , \qquad (3)$$

where $K = (2\pi^2/k^2)E(eV)$ where k is defined below,

E = neutron energy in eV,

$g_J = \frac{(2J+1)}{2(2I+1)}$, where I is the target nucleus spin and J is the compound nucleus spin,

$\langle D_J\rangle$ = mean level spacing in eV spin J resonances,

$\sigma_p = \sum\sigma_{p\ell}$ = potential scattering cross section.

$$\sigma_{p\ell} = 4\pi(2\ell+1)\frac{\sin^2\varphi_\ell}{k^2}$$ Where ℓ is the angular momentum and

$\varphi_0 = k\hat{a}$ where $\hat{a}$ is the scattering radius (A)

$\varphi_1 = k\hat{a} - \tan^{-1}(k\hat{a})$

$\varphi_2 = k\hat{a} - \tan^{-1}\left(\frac{3k\hat{a}}{3-k^2\hat{a}^2}\right)$ where

$$k = 2.196771 \times 10^{-3}\left(\frac{AWRI}{AWRI+1.0}\right)\sqrt{E(eV)}$$

and AWRI is the isotopic mass in units of neutron mass.

Γ_x = is a width in eV to allow for any competing inelastic processes, and the rest of the quantities are different partial widths in eV.

$\Gamma_n = \Gamma_n^\circ \sqrt{E}\, V_\ell \mu_{\ell,J}$ where Γ_n° is the reduced neutron width (GNO(I)), $\mu_{\ell,J}$ is the number of degrees of freedom in the neutron width distribution (AMUN), E the neutron energy and V_ℓ is the penetration factor defined as:

$$V_\ell = 1 \text{ for } \ell = 0$$

$$= \rho^2/(1+\rho^2) \text{ for } \ell = 1$$

$$= \rho^4/(9+3\rho^2+\rho^4) \text{ for } \ell = 2$$

where $\rho = ka$ where k is the wave-number of the neutron in the center-of-mass system (see above) and $a = (1.23(AWRI \times 1.008665)^{1/3} + 0.8) \times 0.1$ is the channel radius in units of 10^{-12}cm. The brackets indicate averaging over the neutron, fission , and any inelastic width fluctuations assumed to follow a χ^2 distribution of different degrees of freedom as given in the ENDF/B data. The summation is over the different spin states J. Hence, allowance is made for possible different degrees of freedom of the fission width distribution corresponding to different spin states. The averaging is done by a method similar to that of Greebler and Hutchins,[10] and corresponds to evaluating the double integrals on a 10 X 10 grid, and ν can vary from 1 to 4. The gamma width Γ_γ is assumed to follow a δ-function type of distribution corresponding to a large number of degrees of freedom in the χ^2 distribution.

Incidentally, we note here that this program (1) takes into account only s-, p-, and d-wave contributions to the cross sections and (2) does take into account inelastic scattering. The scattering radius A in the

unresolved resonance region of ENDF/B File 2 is used to calculate potential scattering while the nuclear radius a defined above is used to calculate nuclear penetrabilities as suggested in the new procedural modifications at the April 1970 CSEWG Meeting.

This program needs 58K (octal) memory for execution.

The data input is explained in great detail in the FORTRAN listing of the program and follows the ENDF/B format except for the first data card which is the title card.

Title Card Format (I10, 7A4)

Read in IRUN, RUN(1), ..., RUN(7)

IRUN = Any run number. If it is zero the program exits if non-zero it indicates the beginning of a new calculation. One can stack any number of these cases one behind the other.

RUN(1), ..., RUN(7) = Any alphanumeric in formation.

REACTOR CODE ABSTRACT

1. Name of Code: AVRAGE4

2. Computer for which Code is designed: CDC-6600

3. Nature of problem solved: This Code calculates average scattering, capture, and fission cross sections from s-, p-, and d-wave data of the unresolved parameters of File 2 of ENDF/B. The parameter corresponds to ENDF/B Version II data with energy dependent neutron, gamme, fission, and inelastic widths.

4. Method of calculation: Theory of average cross section due to Lane and Lynn.[9]

5. Restrictions on the complexity of the problem: This program calculates average cross sections up to 100 energy values in the unresolved region. It allows for inelastic scattering and its width fluctuation and calculates only s-, p-, and d-wave contributions. Maximum $\nu = 4$.

6. Typical running time: Test run calculating s- and p-wave contributions to average scattering, capture, and fission cross sections of Pu-239 at 16 energy points and s- and p-wave contributions to average scattering and capture cross section of U-238 at 19 energy points took 3.5 secs of central processor time on the CDC-6600.

7. Unusual feature of the program: This program can allow for different degrees of freedom for fission width distribution of resonances of different spins.

8. Related auxiliary programs: None.

9. References: A. M. Lane and J. E. Lynn, Proc Phys. Soc. A70, 557 (1957).

10. Machine requirements: Needs 58K octal memory.

11. Programming language: FORTRAN IV.

12. Operating system or monitor: Brookhaven National Laboratory version of CDC Scope 3.0 operating system.

13. Other programming or operating information: None.

14. Name and establishment: M. R. Bhat, National Neutron Cross Section Center, Brookhaven National Laboratory, Upton, New York 11973.

15. Material available: FORTRAN deck with sample output.

16. Category:

References

1. K. Gregson, M. F. James, and D. S. Norton, "MLBW - A Multi-level Breit-Wigner Computer Program," U. K. Atomic Energy Establishment Report AEEW-M517 (1965).

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7. G. W. Hinman, G. F. Kuncir, J. B. Sampson and G. B. West, Nucl. Sci. Eng. 16, 202 (1963).

8. M. R. Bhat and G. E. Lee-Whiting, Nucl. Instruments and Methods 47, 277 (1967).

9. A. M. Lane and J. E. Lynn, Proc. Phys. Soc. A 70, 557 (1957).

10. P. Greebler and B. A. Hutchins, Proc. of the Seminar on Physics of Fast and Intermediate Reactors, IAEA, Vienna 1962, Vol. 3, p. 121.

```
C      PROGRAM SIGPLOT(INPUT,OUTPUT)                                          SIGP001
       COMMON/D/ERAN(2,501)                                                   SIGP002
       COMMON/C/EX(101),JFLAG(101)                                            SIGP003
       COMMON/E/XMIN(6),XMAX(6),XREF(6)                                       SIGP004
       COMMON ARAY,IRAY,ERAY,NOT,ZAI,ABN,NER,LFW,EL,EH,LRU,LRF,LANG,NLS,      SIGP005
      1NRES,LN,JN,PENFAR,SHIFAR,SPI,AP,LIS,C,AM,DREF,AREF,IRANGE,NIS,         SIGP006
      3INCROSS,IVSPIN,ELO,TEFF,DELTA,E,AWR                                    SIGP007
       EXTERNAL MOV,KOM                                                       SIGP008
       EXTERNAL MOVE,KOME                                                     SIGP009
       EXTERNAL DOPPLER                                                       SIGP010
       DIMENSION ARAY(6,500),IRAY(3,500),ERAY(2,500),NOT(20),ZAI(10),         SIGP011
      1ABN(10),NER(10),LFW(10),EL(10,10),EH(10,10),LRU(10,10),LRF(10,10),SIGP012
      2LANG(10,5,5),NLS(10,10),NRES(10),LN(50),JN(150),PENFAR(500),           SIGP013
      3SHIFAR(500),SPI(10),AP(10),LIS(10),C(10),AM(10),DREF(6),AREF(6)        SIGP014
       DIMENSION TITLE(7),XTAB(33)                                            SIGP015
       DATA MAXPTS,MAXRES,ETHERM/2000,100,0,253E-01/                          SIGP016
C---=-THIS A PROGRAM TO CALCULATE SCATTERING,CAPTURE,FISSION AND TOTAL         SIGP017
C-----CROSS-SECTIONS EITHER AS A SUM OF BREIT-WIGNER TERMS OR WITH A           SIGP018
C-----MULTI-LEVEL FORMULA TAKING INTO ACCOUNT LEVEL-LEVEL INTERFERENCE,        SIGP019
C-----RUNS ON BOTH CDC-6600 AND PDP-10                                         SIGP0191
C      11111111111111111111111111111111111111111111111111111111111111111111SIGP020
            READ1,(TITLE(I),I=1,7),IDPL,TEFF,NTAB,INCROSS,ERROR,IVSPIN       SIGP021
C-----IDPL=1 IF DOPPLER BROADENED CROSS-SECTIONS ARE DESIRED,ELSE IDPL=0      SIGP022
C---=-TEFF=EFFECTIVE TEMPERATURE OF THE TARGET IN DEGREES KELVIN,              SIGP023
C---=-NTAB=NUMBER OF PIVOT POINTS TO BE USED IN EVALUATING THE DOPPLER        SIGP024
C-----BROADENED CROSS-SECTION. TO GET THE DOPPLER BROADENED CROSS-SECTIOSIGP025
C-----N AT EVERY ENERGY E WE TAKE THE INTERVAL E-N2*DELTA TO E+N2*DELTA       SIGP026
C---=-FOR THE INTEGRAL WHERE N2=NTAB/2 AND DELTA IS THE DOPPLER CONSTANTSIGP027
C---=-NTAB=11 OR SO SHOULD SUFFICE FOR ALL CASES, NTAB= ODD INTEGER,          SIGP028
C---=-ERROR=  IF THE RELATIVE ERROR BETWEEN TWO SUCCESSIVE ITERATIONS         SIGP029
C---=-OF THE DOPPLER INTEGRAL IS LESS THAN ERROR THE INTEGRATION ROUTINESIGP030
C---=-ASSUMES THAT THE INTEGRAL HAS CONVERGED AND IT EXITS, TYPICAL           SIGP031
C---=-VALUES COULD BE=1.0E-04, HOWEVER IT IS RECOMMENDED THAT THE USER       SIGP032
C-----EXERCISE HIS JUDGEMENT IN FEEDING THIS VALUE COMMENSURATE WITH THESIGP033
C-----ACCURACY OF THE FINAL RESULT DESIRED AND COMPUTER TIME AVAILABLE,      SIGP034
C-----IN PRACTICE IT IS FOUND THAT THE SPINS OF ONLY A FEW RESONANCES ARSIGP035
C-----KNOWN AS A RESULT OF DIRECT MEASUREMENT WHILE REST OF THE RESONANCSIGP036
C---=-ES ARE ASSIGNED AN AVERAGE SPIN WHICH IS EQUAL TO THE AVERAGE OF       SIGP037
C---=-ALL POSSIBLE SPINS  FOR THE PARTICULAR PARTIAL WAVE, THIS AVERAGE      SIGP038
C---=-SPIN IS CALCULATED FOR A GIVEN TARGET NUCLEUS SPIN AND A GIVENL-VASIGP039
C---=-IN THIS PROGRAM IN CALCULATING THE SCATTERING CROSS-SECTION WITH       SIGP040
C-----LEVEL-LEVEL INTERFERENCE, RESONANCES OF A PARTICULAR SPIN VALUE        SIGP041
C---=-INTERFERE AMONGST THEMSELVES, HOWEVER,IF A GROUP OF RESONANCES HASSIGP042
C-----SPIN EQUAL TO THE AVERAGE SPIN ,THEIR MUTUAL INTERFERENCE TERM IS SIGP043
C---=-SET EQUAL TO ZERO.IF IT IS DESIRED TO INCLUDE THIS MUTUAL INTERFERSIGP044
C---=-TERM PUNCH A 1 IN COLUMN 65 ELSE PUNCH A 0,                           SIGP045
                  PRINT24,(TITLE(I),I=1,7)                                 SIGP046
       PRINT25                                                             SIGP047
    1 FORMAT(7A4,2X,I5,F5.1,2I5,E10.4,I5)                                  SIGP048
      IF(IDPL.EQ.1)GO TO 1011                                              SIGP049
      GO TO 1012                                                           SIGP0491
 1011 PRINT25                                                              SIGP050
      PRINT30,TEFF,NTAB,ERROR,INCROSS                                      SIGP051
      PRINT25                                                              SIGP052
      GO TO 1013                                                           SIGP053
 1012 CONTINUE                                                             SIGP054
C      22222222222222222222222222222222222222222222222222222222222222222222SIGP055
 1013             READ3,ZA,AWR,NOT(1),NOT(2),NIS,NOT(3)                    SIGP056
C---=-ZA=(Z,A)DESIGNATION OF MATERIAL,AWR=AT.WT/NEUTRON MASS,NIS=NO OF      SIGP057
C---=-ISOTOPES                                                             SIGP058
C-----IN THE CURRENT ENDF/B FORMAT INDIVIDUAL ISOTOPE MASSES ARE NOT        SIGP059
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C---=-GIVEN HENCE WE USE AWR WHICH IS MASS OF THE ELEMENT,                SIGP060
                  PRINT17,ZA,AWR,NIS                                     SIGP061
      PRINT25                                                            SIGP062
      J1=1                                                               SIGP063
      JFIO=1                                                             SIGP064
      DO 101 I=1,NIS                                                     SIGP065
      NRANGE=1                                                           SIGP066
C     333333333333333333333333333333333333333333333333333333333333333SIGP067
      PRINT25                                                            SIGP068
                  PRINT18,I                                              SIGP069
      PRINT25                                                            SIGP070
                  READ3,ZAI(I),ABN(I),NOT(4),LFW(I),NER(I),NOT(5)        SIGP071
C---=-ZAI(I)=(Z,A) DESIGNATION OF ITH ISOTOPE ABN(I)=WT FRACTION OF ITH  SIGP072
C---=-ISOTOPE LFW=1 FISSION WIDTHS ARE GIVEN,=0 FISSION WIDTHS NOT GIVENSIGP073
C---=-NER(I)=NO OF ENERGY RANGES USED                                    SIGP074
                  PRINT19,ZAI(I),ABN(I),NER(I)                           SIGP075
      NERI=NER(I)                                                        SIGP076
      J2=1                                                               SIGP077
C     444444444444444444444444444444444444444444444444444444444444444SIGP078
  106                 READ3,EL(I,J2),EH(I,J2),LRU(I,J2),LRF(I,J2),NOT(6),NOSIGP079
     1T(7)                                                               SIGP080
C---=-EL=LOWER ENERGY LIMIT OF A RANGE, EH=UPPER LIMIT OF A RANGE        SIGP081
C---=-LRU=1 RESOLVED RESONANCE PARAMETERS,LRU=2 UNRESOLVED  PARAMTRS     SIGP082
C---=-LRF INDICATES PARTICULAR TYPE OF RESONANCE FORMULA TO BE USED      SIGP083
                  PRINT20,EL(I,J2),EH(I,J2),LRU(I,J2),LRF(I,J2)         SIGP084
      LRUIJ=LRU(I,J2)                                                    SIGP085
      IF(LRUIJ-1)127,128,1010                                            SIGP086
  127 PRINT10                                                            SIGP087
      GO TO 130                                                          SIGP088
  128 NMOM=1                                                             SIGP089
C     555555555555555555555555555555555555555555555555555555555555555SIGP090
                  READ3,SPI(I),AP(I),LIS(I),NOT(8),NLS(I,J2),NOT(9)      SIGP091
C---=-SPI(I)=SPIN OF THE I-TH ISOTOPE,AP(I)=A* SPIN DEPENDENT SCATTERINGSIGP092
C-----LENGTH IN UNITS OF 1.0E-12CM.AM(I)=A-, FOR SPIN INDEPENDENCEAM(I)=SIGP093
C-----0,LIS(I)=0 IMPLIES CALCULATE SCATTERING X-SECN FROM RESONANCE PARASIGP094
C-----METERS PLUS FILE3,LIS(I)=1 IMPLIES CALCULATE CROSS-SECN FROM FILE3SIGP095
C---=-ONLY, NLS=NUMBER OF L-VALUES                                       SIGP096
                  PRINT21,SPI(I),AP(I),NLS(I,J2),LIS(I)                 SIGP097
      JL=1                                                               SIGP098
C     666666666666666666666666666666666666666666666666666666666666666SIGP099
  104                 READ3,C(I),AM(I),LANG(I,J2,JL),NOT(10),NRSOX,NRS   SIGP100
C---=-C=CONST USED TO CALCULATE RHO=C*SQRT(E),AM=SEE ABOVE,LANG=L-VALUE  SIGP101
C---=-OF THE ANGULAR MOMENTUM NRS=NUMBER OF RESONANCES                   SIGP102
                  PRINT22,C(I),AM(I),LANG(I,J2,JL),NRS                  SIGP103
      NMOM=NMOM+1                                                        SIGP104
      J3=J1+(NRS-1)                                                      SIGP105
C     777777777777777777777777777777777777777777777777777777777777777SIGP106
                  READ4,((ARAY(K,J),K=1,6),J=J1,J3)                      SIGP107
C     THIS IS WHERE THE RESONANCE PARAMETERS ARE READ IN, ARAY(1,J)=ERESSIGP108
C     IN EV, ARAY(2,J)=J VALUE,ARAY(3,J)=TOTAL GAMMA, ARAY(4,J)=NEUTRON SIGP109
C     WIDTH,ARAY(5,J)=GAMMA GAMMA, ARAY(6,J)=FISSION WIDTH, ALL WIDTHS ISIGP110
C     N EV.                                                              SIGP111
      PRINT25                                                            SIGP112
                  PRINT23                                                SIGP113
                  PRINT26,((ARAY(K,J),K=1,6),J=J1,J3)                    SIGP114
      PRINT25                                                            SIGP115
      DO 102 J=J1,J3                                                     SIGP116
      IRAY(1,J)=LANG(I,J2,JL)                                            SIGP117
      IRAY(2,J)=NRANGE                                                   SIGP118
      IRAY(3,J)=I                                                        SIGP119
      ERAY(1,J)=SPI(I)                                                   SIGP120
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      ERAY(2,J)=AP(I)                                                   SIGP121
  102 CONTINUE                                                          SIGP122
      J1=J1+NRS                                                         SIGP123
      JL=JL+1                                                           SIGP124
      IF(NMOM-NLS(I,J2))104,104,103                                     SIGP125
  103 NRANGE=NRANGE+1                                                   SIGP126
      J2=J2+1                                                           SIGP127
      IF(NRANGE-NERI)106,106,1010                                       SIGP128
 1010 NRES(I)=J1-JFID                                                   SIGP129
      JFID=J1                                                           SIGP130
  101 CONTINUE                                                          SIGP131
      NTOTAL=J1-1                                                       SIGP132
      SCALE=1.0E+00                                                     SIGP133
      PHI=3.14159265                                                    SIGP134
    3 FORMAT(2E11.4,4I11)                                               SIGP135
    4 FORMAT(6E11.4)                                                    SIGP136
    5 FORMAT(8E11.4,3I10)                                               SIGP137
    6 FORMAT(2X,2E11.4)                                                 SIGP138
    7 FORMAT(107H NEUTRON ENERGY( EV)    SIGNN          SIGCAP          SSIGP139
     1IGF          SIGT          SIGNNMULT      SIGTMULT  )            SIGP140
    8 FORMAT(2X,7E15.6)                                                 SIGP141
    9 FORMAT(10X,2E20.6)                                                SIGP142
   10 FORMAT(20H ERROR IN INPUT DATA)                                   SIGP143
   11 FORMAT(10X,2I10)                                                  SIGP144
   12 FORMAT(10X,6I10)                                                  SIGP145
   16 FORMAT(15H NEUTRON ENERGYE15,6)                                   SIGP146
   14 FORMAT(53H CROSS-SECTIONS CALCULATED WITHOUT DOPPLER BROADENING)  SIGP147
   15 FORMAT(50H CROSS-SECTIONS CALCULATED WITH DOPPLER BROADENING)     SIGP148
   17 FORMAT(33H (Z,A) DESIGNATION OF THE ELEMENTE11.4,22H AT.WT/MASS OFSIGP149
     1 NEUTRONE11.4,15H NO OF ISOTOPESI5)                               SIGP150
   18 FORMAT(24H DATA FOR ISOTOPE NUMBERI5)                             SIGP151
   19 FORMAT(33H (Z,A) DESIGNATION OF THE ISOTOPEE11.4,21H FRACTIONAL ABSIGP152
     1UNDANCEE11.4,20H NO OF ENERGY RANGESI5)                           SIGP153
   20 FORMAT(36H LOWER LIMIT OF THE ENERGY RANGE(EV)E11.4,18H   UPPER LISIGP154
     1MIT(EV)E11.4,6H  LRU=I5,6H  LRF=I5)                               SIGP155
   21 FORMAT(13H NUCLEAR SPINE11.4,18H SCATTERING LENGTHE11.4,15H NO OF SIGP156
     1L-VALUESI5,6H  LIS=I5)                                            SIGP157
   22 FORMAT(41H CONSTANT USED TO CALCULATE PENETRABILITYE11.4,22H SCATTSIGP158
     1ERING LENGTH(A-)E11.4,17H ANGULAR MOMENTUMI5,17H NO OF RESONANCESISIGP159
     25)                                                                SIGP160
   23 FORMAT(85H      ERES           SPIN           GTOT            GN  SIGP161
     1         GGAMMA          GF )                                     SIGP162
   24 FORMAT(11H1TITLE     7A4)                                         SIGP163
   25 FORMAT(//)                                                        SIGP164
   26 FORMAT(6(2X,E11.4,2X))                                            SIGP165
   27 FORMAT(33H CROSS-SECTIONS AT THERMAL ENERGY)                      SIGP166
   28 FORMAT(2X,2E20.6,I10)                                             SIGP167
   29 FORMAT(2X,4E11.4)                                                 SIGP168
   30 FORMAT(22H EFFECTIVE TEMPERATUREF5.1,41H  IN DEGREES KELVIN,   NO SIGP169
     1OF PIVOT POINTSI5,18H CONVERGENCE ERRORE10.4,13H AND INCROSS=I5)  SIGP170
   31 FORMAT(53H THE INTEGRAL FOR DOPPLER BROADENING DID NOT CONVERGE)  SIGP171
C----THIS IS WHERE RESONANCES OF EACH ISOTOPE ARE ARRANGED IN INCREASINSIGP172
C---GG ORDER IN L AND FOR EACH L IN INCREASING ORDER IN J.              SIGP173
      DO 133 I=1,NIS                                                    SIGP174
      NRESI=NRES(I)                                                     SIGP175
      CALL ORDER(I,NRESI)                                               SIGP176
  133 CONTINUE                                                          SIGP177
   13 FORMAT(10(1X,I10))                                                SIGP178
      DO 135I=1,NTOTAL                                                  SIGP179
      ARAY(1,I)=ARAY(1,I)*SCALE                                         SIGP180
      ARAY(3,I)=ARAY(3,I)*SCALE                                         SIGP181
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      ARAY(4,I)=ARAY(4,I)*SCALE                                          SIGP182
      ARAY(5,I)=ARAY(5,I)*SCALE                                          SIGP183
      ARAY(6,I)=ARAY(6,I)*SCALE                                          SIGP184
  135 CONTINUE                                                           SIGP185
      NCOUNT=1                                                           SIGP186
      DO 1330 I=1,NIS                                                    SIGP187
      APX=AP(I)                                                          SIGP188
      NRESI=NRES(I)                                                      SIGP189
      NLMT=NCOUNT+NRESI-1                                                SIGP190
      DO 1331 J=NCOUNT,NLMT                                              SIGP191
      CALL FACTS(ARAY(1,J),IRAY(1,J),PENFAR(J),SHIFAR(J),PS,CONST,AWR,   SIGP192
     1APX,1.0)                                                           SIGP193
 1331 CONTINUE                                                           SIGP194
      NCOUNT=NCOUNT+NRESI                                                SIGP195
 1330 CONTINUE                                                           SIGP196
      DO 108 I=1,NTOTAL                                                  SIGP197
      ERAN(1,I)=ARAY(1,I)                                                SIGP198
      ERAN(2,I)=ARAY(3,I)                                                SIGP199
  108 CONTINUE                                                           SIGP200
      CALL QIKS(1,NTOTAL,MOV,KOM)                                        SIGP201
C-----HERE RESONANCE IN AN ELEMENT ARE ARRANGED IN INCREASING ORDER IN   SIGP202
C-----ENERGY ALONG WITH THEIR TOTAL GAMMAS TO CALCULATE THE ENERGY MESH  SIGP203
C-----AT WHICH THE CROSS-SECTIONS ARE CALCULATED.                        SIGP204
  146 PRINT27                                                            SIGP205
      PRINT25                                                            SIGP206
      PRINT7                                                             SIGP207
      E=ETHERM                                                           SIGP208
      CALL SIGMA(ETHERM,AWR,1)                                           SIGP209
      PRINT25                                                            SIGP210
      ELO=EL(1,1)*SCALE                                                  SIGP211
      JFLAG(1)=1                                                         SIGP212
      IRANGE=1                                                           SIGP213
C-----WE HAVE ARBITRARILY SET ELO=1.0E-11 MEV HERE TO BE ABLE TO DOPPLERSIGP214
C-----BROADEN THERMAL CROSS-SECTIONS,LATER ON IN THE PROGRAM ELO IS READSIGP215
C-----IN FROM THE DATA AND COULD VARY FROM 1.0E-11 TO 1.0E+09MEV.        SIGP216
      PRINT8,ETHERM,(AREF(LL),LL=1,6)                                    SIGP217
      IF(IDPL.EQ.1)GO TO 147                                             SIGP218
      GO TO 148                                                          SIGP2181
  147 TEF=TEFF/293.0                                                     SIGP219
      DELTA=0.3177*SQRT ((TEF*ETHERM)/AWR)                               SIGP220
C     CONTINUE                                                           SIGP221
      CALL GRID(ETHERM,DELTA,NTAB,XTAB)                                  SIGP222
      CALL GREAT2(DOPPLER,FINT,XTAB,NTAB,ERROR,IERR)                     SIGP223
      PRINT28,ETHERM,FINT,JFLAG(1)                                       SIGP224
      IF(IERR.EQ.1)PRINT31                                               SIGP225
  148 PRINT25                                                            SIGP226
      PRINT7                                                             SIGP227
      PRINT25                                                            SIGP228
      DO 124 JJ=1,NIS                                                    SIGP229
      NERJJ=NER(JJ)                                                      SIGP230
      DO 125 KK=1,NERJJ                                                  SIGP231
      IRANGE=KK                                                          SIGP232
      LRUJK=LRU(JJ,KK)                                                   SIGP233
      IF(LRUJK-1)131,1321,125                                            SIGP234
  131 PRINT10                                                            SIGP235
      GO TO 130                                                          SIGP236
 1321 IF(JJ.EQ.1)GO TO 1320                                              SIGP237
      GO TO 132                                                          SIGP2371
 1320 ELOREF=EL(JJ,KK)*SCALE                                             SIGP238
      EHIREF=EH(JJ,KK)*SCALE                                             SIGP239
      ELO=ELOREF                                                         SIGP240
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      EHI=EHIREF                                                        SIGP241
      GO TO 1240                                                        SIGP242
  132 ELO=EL(JJ,KK)*SCALE                                               SIGP243
      EHI=EH(JJ,KK)*SCALE                                               SIGP244
      IF(ELO.EQ.ELOREF.AND.EHI.EQ.EHIREF)GO TO 124                      SIGP245
      GO TO 1240                                                        SIGP2451
 1240 MM=MAXPTS/(8*MAXRES)                                              SIGP246
      NN=MM                                                             SIGP247
      IFLAG=1                                                           SIGP248
      NLSKK=NLS(JJ,KK)                                                  SIGP249
      J4=1                                                              SIGP250
      ISTART=1                                                          SIGP251
      IEND=1                                                            SIGP252
  117 IF(IEND.EQ.0)GO TO 125                                            SIGP253
      J5=J4+1                                                           SIGP254
      E1=ERAN(1,J4)                                                     SIGP255
      G1=ERAN(2,J4)                                                     SIGP256
      E2=ERAN(1,J5)                                                     SIGP257
      G2=ERAN(2,J5)                                                     SIGP258
      IF(E1.LT.ELO.AND.E2.LT.ELO)GO TO 1120                             SIGP259
      GO TO 1105                                                        SIGP2591
 1105 IF(E1.LE.ELO.AND.E2.GT.ELO)GO TO 1110                             SIGP260
      GO TO 1111                                                        SIGP2601
 1110 E1=ELO                                                            SIGP261
      G1=G2                                                             SIGP262
      ISTART=0                                                          SIGP263
      GO TO 1114                                                        SIGP264
 1111 IF(E1.GT.ELO.AND.E2.LE.EHI)GO TO 1112                             SIGP265
      GO TO 1113                                                        SIGP2651
 1112 IF(J4.EQ.1.AND.ISTART.EQ.1)GO TO 1106                             SIGP266
      GO TO 1114                                                        SIGP2661
 1106 E2=E1                                                             SIGP267
      G2=G1                                                             SIGP268
      E1=ELO                                                            SIGP269
      J4=J4-1                                                           SIGP270
      ISTART=0                                                          SIGP271
      GO TO 1114                                                        SIGP272
 1116 E2=EHI+G1/FLOAT(MM)                                               SIGP273
      G2=G1                                                             SIGP274
      IFLAG=0                                                           SIGP275
      GO TO 1114                                                        SIGP276
 1113 IF(E1.LT.EHI.AND.E2.GE.EHI)GO TO 1123                             SIGP277
      GO TO 1124                                                        SIGP2771
 1123 E2=EHI                                                            SIGP278
      G2=G1                                                             SIGP279
      IEND=0                                                            SIGP280
      GO TO 1114                                                        SIGP281
 1124 IF(E1.GE.EHI.AND.E2.GT.EHI)GO TO 125                              SIGP282
      GO TO 1125                                                        SIGP2821
 1125 IF(IFLAG)1120,125,1120                                            SIGP283
 1114 IF(E1.EQ.E2)GO TO 1120                                            SIGP284
      GO TO 1118                                                        SIGP2841
 1118 CONTINUE                                                          SIGP285
      CALL SIEVE(E1,G1,E2,G2,MM,NN,NX,TEFF,AWR)                         SIGP286
      CALL QIKS(1,NX,MOVE,KOME)                                         SIGP287
      GO TO 116                                                         SIGP288
 1120 IF(IEND.EQ.0)GO TO 125                                            SIGP289
      J4=J4+1                                                           SIGP290
      GO TO 117                                                         SIGP291
  116 DO 109 I=1,NX                                                     SIGP292
      E=EX(I)                                                           SIGP293
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      JFLAGI=JFLAG(I)                                                   SIGP294
      CALL SIGMA(E,AWR,KK)                                              SIGP295
      PRINT8,E,(AREF(LL),LL=1,6)                                        SIGP296
      IF(IDPL.EQ.1)GO TO 141                                            SIGP297
      GO TO 109                                                         SIGP2971
  141 IF(E.LT.ETHERM)GO TO 109                                          SIGP298
      GO TO 1410                                                        SIGP2981
C---=-IF THE NEUTRON ENERGY IS LESS THAN 0.0253 EV DOPPLER BROADENING ISSIGP299
C---=-PASSED AS A DIFFERENT KERNEL SHOULD BE USED TO CALCULATE DOPPLER  SIGP300
C-----BROADENED CROSS-SECTIONS.                                         SIGP301
 1410 TEF=TEFF/293.0                                                    SIGP302
      DELTA=0.3177*SQRT ((TEF*E)/AWR)                                   SIGP303
C     CONTINUE                                                          SIGP304
      GO TO (1121,1122),JFLAGI                                          SIGP305
 1121 CALL GRID(E,DELTA,NTAB,XTAB)                                      SIGP306
   32 FORMAT(2X,11E11.4)                                                SIGP307
      CALL GREAT2(DOPPLER,FINT,XTAB,NTAB,ERROR,IERR)                    SIGP308
      PRINT28,E,FINT,JFLAG(I)                                           SIGP309
      IF(IERR.EQ.1)PRINT31                                              SIGP310
      GO TO 109                                                         SIGP311
 1122 CALL GAUSS(E,DELTA,DOPE)                                          SIGP312
      PRINT28,E,DOPE,JFLAG(I)                                           SIGP313
  109 CONTINUE                                                          SIGP314
      IF(IFLAG)1117,125,1117                                            SIGP315
 1117 J4=J4+1                                                           SIGP316
      IF(NTOTAL-J4)125,1250,117                                         SIGP317
 1250 E1=ERAN(1,J4)                                                     SIGP318
      G1=ERAN(2,J4)                                                     SIGP319
      GO TO 1116                                                        SIGP320
  125 CONTINUE                                                          SIGP321
  124 CONTINUE                                                          SIGP322
  120 CONTINUE                                                          SIGP323
  130 CALL EXIT                                                         SIGP324
      END                                                               SIGP325
      SUBROUTINE ORDER(K,N1)                                            ORDR001
      COMMON ARAY,IRAY,ERAY,NOT,ZAI,ABN,NER,LFW,EL,EH,LRU,LRF,LANG,NLS, ORDR002
     1NRES,LN,JN,PENFAR,SHIFAR,SPI,AP,LIS,C,AM,DREF,AREF,IRANGE,NIS,    ORDR003
     3INCROSS,IVSPIN,ELO,TEFF,DELTA,E,AWR                               ORDR004
      DIMENSION ARAY(6,500),IRAY(3,500),ERAY(2,500),NOT(20),ZAI(10),    ORDR005
     1ABN(10),NER(10),LFW(10),EL(10,10),EH(10,10),LRU(10,10),LRF(10,10),ORDR006
     2LANG(10,5,5),NLS(10,10),NRES(10),LN(50),JN(150),PENFAR(500),SHIFARORDR007
     3(500),SPI(10),AP(10),LIS(10),C(10),AM(10),DREF(6),AREF(6)         ORDR008
      IF(K-1)2,2,3                                                      ORDR009
    2 NTR=0                                                             ORDR010
      NUML=0                                                            ORDR011
      NUMJ=0                                                            ORDR012
      NN=0                                                              ORDR013
      MM=0                                                              ORDR014
      JJ=0                                                              ORDR015
      NC=0                                                              ORDR016
      MC=0                                                              ORDR017
    3 NT=NTR+1                                                          ORDR018
      NTR=NTR+N1                                                        ORDR019
      OL=-0.9                                                           ORDR020
    8 OL=OL+1.0                                                         ORDR021
      DO 101 N=NT,NTR                                                   ORDR022
      TERM=FLOAT (IRAY(1,N))                                            ORDR023
      IF(OL-TERM)101,101,9                                              ORDR024
    9 NN=NN+1                                                           ORDR025
      DO 100J=1,6                                                       ORDR026
      A=ARAY(J,N)                                                       ORDR027
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      ARAY(J,N)=ARAY(J,NN)                                                  ORDR028
      ARAY(J,NN)=A                                                          ORDR029
  100 CONTINUE                                                              ORDR030
      DO 1001 J=1,3                                                         ORDR031
      IA=IRAY(J,N)                                                          ORDR032
      IRAY(J,N)=IRAY(J,NN)                                                  ORDR033
      IRAY(J,NN)=IA                                                         ORDR034
 1001 CONTINUE                                                              ORDR035
      DO 1002 J=1,2                                                         ORDR036
      EA=ERAY(J,N)                                                          ORDR037
      ERAY(J,N)=ERAY(J,NN)                                                  ORDR038
      ERAY(J,NN)=EA                                                         ORDR039
 1002 CONTINUE                                                              ORDR040
  101 CONTINUE                                                              ORDR041
      IF(NN-NC)8,8,11                                                       ORDR042
   11 NUML=NUML+1                                                           ORDR043
      LN(NUML)=NN-NC                                                        ORDR044
      NC=NN                                                                 ORDR045
      NU=NT+LN(NUML)-1                                                      ORDR046
      OM=.25                                                                ORDR047
   14 OM=OM+.5                                                              ORDR048
      DO 205 M=NT,NU                                                        ORDR049
      TERMJ=ARAY(2,M)                                                       ORDR050
      IF(OM-TERMJ)205,205,15                                                ORDR051
   15 MM=MM+1                                                               ORDR052
      DO 204 J=1,6                                                          ORDR053
      A=ARAY(J,M)                                                           ORDR054
      ARAY(J,M)=ARAY(J,MM)                                                  ORDR055
      ARAY(J,MM)=A                                                          ORDR056
  204 CONTINUE                                                              ORDR057
      DO 2041 J=1,3                                                         ORDR058
      IA=IRAY(J,M)                                                          ORDR059
      IRAY(J,M)=IRAY(J,MM)                                                  ORDR060
      IRAY(J,MM)=IA                                                         ORDR061
 2041 CONTINUE                                                              ORDR062
      DO 2042 J=1,2                                                         ORDR063
      EA=ERAY(J,M)                                                          ORDR064
      ERAY(J,M)=ERAY(J,MM)                                                  ORDR065
      ERAY(J,MM)=EA                                                         ORDR066
 2042 CONTINUE                                                              ORDR067
  205 CONTINUE                                                              ORDR068
      IF(MM-MC)14,14,16                                                     ORDR069
   16 NUMJ=NUMJ+1                                                           ORDR070
      JN(NUMJ)=MM-MC                                                        ORDR071
      MC=MM                                                                 ORDR072
      NT=NT+JN(NUMJ)                                                        ORDR073
      IF(NN-MM)17,17,14                                                     ORDR074
   17 IF(NTR-NN)18,18,8                                                     ORDR075
   18 RETURN                                                                ORDR076
      END                                                                   ORDR077
      SUBROUTINE SIGMA(Q,BWR,KK)                                            SIGM001
      COMMON/E/XMIN(6),XMAX(6),XREF(6)                                      SIGM002
      COMMON ARAY,IRAY,ERAY,NOT,ZAI,ABN,NER,LFW,EL,EH,LRU,LRF,LANG,NLS,     SIGM003
     1NRES,LN,JN,PENFAR,SHIFAR,SPI,AP,LIS,C,AM,DREF,AREF,IRANGE,NIS,        SIGM004
     3INCROSS,IVSPIN,ELO,TEFF,DELTA,E,AWR                                   SIGM005
      DIMENSION ARAY(6,500),IRAY(3,500),ERAY(2,500),NOT(20),ZAI(10),        SIGM006
     1ABN(10),NER(10),LFW(10),EL(10,10),EH(10,10),LRU(10,10),LRF(10,10),SIGM007
     2LANG(10,5,5),NLS(10,10),NRES(10),LN(50),JN(150),PENFAR(500),SHIFARSIGM008
     3(500),SPI(10),AP(10),LIS(10),C(10),AM(10),DREF(6),AREF(6)          SIGM009
      PI=3.14159265359                                                      SIGM010
      DO 4 J=1,6                                                            SIGM011
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      AREF(J)=0.0                                                       SIGM012
    4 CONTINUE                                                          SIGM013
      TERROR=1.0E-03                                                    SIGM014
      L2=0                                                              SIGM015
      N2=0                                                              SIGM016
      LA=0                                                              SIGM017
      JA=0                                                              SIGM018
      NTR=0                                                             SIGM019
      DO 112 I=1,NIS                                                    SIGM020
      NRESI=NRES(I)                                                     SIGM021
      API=AP(I)                                                         SIGM022
    3 NTR=NTR+NRESI                                                     SIGM023
      IF(NRESI)110,110,100                                              SIGM024
  100 LA=LA+1                                                           SIGM025
  102 L2=L2+LN(LA)                                                      SIGM026
      CALL FACTS(Q,IRAY(1,L2),PF,SF,PS,CONSTE,BWR,API,3,0)              SIGM027
      SNGLN=0.0                                                         SIGM028
      SNGLG=0.0                                                         SIGM029
      SNGLF=0.0                                                         SIGM030
      SNNL2=0.0                                                         SIGM031
  103 JA=JA+1                                                           SIGM032
  104 N1=N2+1                                                           SIGM033
      N2=N2+JN(JA)                                                      SIGM034
      GJ=2.0*(2.0*SPI(I)+1.0)                                           SIGM035
      GJ=(2.0*ARAY(2,N1)+1.0)/GJ                                        SIGM036
      X=1.0                                                             SIGM037
      SPIN=ARAY(2,N1)                                                   SIGM038
       SPII=SPI(I)                                                      SIGM039
      CALL SPINOR(SPII,IRAY(1,L2),XSPIN)                                SIGM040
      ABDIF=ABS (XSPIN-SPIN)                                            SIGM041
      IF(IVSPIN.EQ.1)GO TO 115                                          SIGM042
      GO TO 116                                                         SIGM0421
  116 IF(ABDIF.LT.TERROR)GO TO 117                                      SIGM043
      GO TO 115                                                         SIGM0431
  117 X=0.0                                                             SIGM044
  115 SNNK23=0.0                                                        SIGM045
      DO 108 K=N1,N2                                                    SIGM046
      GNK=PF*ARAY(4,K)/PENFAR(K)                                        SIGM047
      GK=GNK*ARAY(5,K)*ARAY(6,K)                                        SIGM048
      ERDK=ARAY(1,K)+((SHIFAR(K)-SF)*ARAY(4,K))/(2.0*PENFAR(K))         SIGM049
      ED=Q-ERDK                                                         SIGM050
      DK=ED*ED*0.25*GK*GK                                               SIGM051
      SNNK2=GNK*GNK*COS (2.0*PS)                                        SIGM052
      SNNK2=SNNK2-2.0*GNK*(ARAY(5,K)+ARAY(6,K))*SIN(PS)*SIN(PS)         SIGM053
      SNNK2=SNNK2+2.0*GNK*ED*SIN (2.0*PS)                               SIGM054
      SNNK2=SNNK2/DK                                                    SIGM055
      SNGK=GNK*ARAY(5,K)/DK                                             SIGM056
      SNFK=GNK*ARAY(6,K)/DK                                             SIGM057
      SNGLN=SNGLN+SNNK2*GJ                                              SIGM058
      SNGLG=SNGLG+SNGK*GJ                                               SIGM059
      SNGLF=SNGLF+SNFK*GJ                                               SIGM060
      SNNK3=0.0                                                         SIGM061
      IF(K-N1)107,107,105                                               SIGM062
  105 M1=K-1                                                            SIGM063
      DO 106 M=N1,M1                                                    SIGM064
      GNM=PF*ARAY(4,M)/PENFAR(M)                                        SIGM065
      GM=GNM*ARAY(5,M)*ARAY(6,M)                                        SIGM066
      ERDM=ARAY(1,M)+((SHIFAR(M)-SF)*ARAY(4,M))/(2.0*PENFAR(M))         SIGM067
      EDD=Q-ERDM                                                        SIGM068
      DM=EDD*EDD+0.25*GM*GM                                             SIGM069
      SNNM3=ED*EDD+0.25*GK*GM                                           SIGM070
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      SNNM3=SNNM3*2.Ø*GNK*GNM/(DM*DK)                                   SIGMØ71
      SNNK3=SNNK3+SNNM3                                                 SIGMØ72
  106 CONTINUE                                                          SIGMØ73
  107 CONTINUE                                                          SIGMØ74
      SNNK23=SNNK23+SNNK2*SNNK3*X                                       SIGMØ75
  108 CONTINUE                                                          SIGMØ76
      SNNL2=SNNL2+SNNK23*GJ                                             SIGMØ77
      IF(L2-N2)1Ø9,1Ø9,1Ø3                                              SIGMØ78
  109 BETA=PI*ABN(I)/(CONSTE*CONSTE)                                    SIGMØ79
       AREF(1)=AREF(1)+SNGLN*BETA                                       SIGMØ8Ø
      AREF(2)=AREF(2)+SNGLG*BETA                                        SIGMØ81
      AREF(3)=AREF(3)+SNGLF*BETA                                        SIGMØ82
      AREF(4)=AREF(4)+BETA*(SNGLN+SNGLG+SNGLF)                          SIGMØ83
      AREF(5)=AREF(5)+SNNL2*BETA                                        SIGMØ84
      AREF(6)=AREF(6)+BETA*(SNGLG+SNGLF+SNNL2)                          SIGMØ85
      IF(L2-NTR)1ØØ,11Ø,11Ø                                             SIGMØ86
  11Ø SIGP=Ø.Ø                                                          SIGMØ87
      LRUJK=LRU(I,KK)                                                   SIGMØ88
      IF(LRUJK-1)125Ø,125Ø,125                                          SIGMØ89
 125Ø NLSKK=NLS(I,KK)                                                   SIGMØ9Ø
      DO 126 LL=1,NLSKK                                                 SIGMØ91
      LURE=LANG(I,KK,LL)                                                SIGMØ92
      SS=FLOAT (LURE)                                                   SIGMØ93
      CALL FACTS(Q,LURE,PF,SF,PS,CONSTA,BWR,API,3,Ø)                    SIGMØ94
      TRM=(2.Ø*SS+1.Ø)*4.Ø*PI                                           SIGMØ95
      TRM=TRM*SIN(PS)*SIN(PS)/(CONSTA*CONSTA)                           SIGMØ96
      SIGP=SIGP+TRM                                                     SIGMØ97
  126 CONTINUE                                                          SIGMØ98
  125 AREF(1)=AREF(1)+SIGP*ABN(I)                                       SIGMØ99
      AREF(4)=AREF(4)+SIGP*ABN(I)                                       SIGM1ØØ
      AREF(5)=AREF(5)+SIGP*ABN(I)                                       SIGM1Ø1
      AREF(6)=AREF(6)+SIGP*ABN(I)                                       SIGM1Ø2
  112 CONTINUE                                                          SIGM1Ø3
      RETURN                                                            SIGM1Ø4
      END                                                               SIGM1Ø5
      SUBROUTINE FACTS(Q,L,PF,SF,PS,CONSTE,BWR,BP,PLOD)                 FACTØØ1
C                                                                       FACTØØ2
C     SUBROUTINE TO CALCULATE PENETRATION AND                           FACTØØ3
C              SHIFT FACTORS                                            FACTØØ4
C     Q IS THE ENERGY L IS THE ANGULAR MOMENTUM PF PENETRATION FACTOR   FACTØØ5
C     SF THE SHIFT FACTOR AND PS THE PHASE SHIFT AP IS R CONSTE IS KM   FACTØØ6
C     FOR DETAILS OF FORMULAE SEE GREGSON ET AL AEEW-M517(MLBW)1965     FACTØØ7
C                                                                       FACTØØ8
      DATA WNEUT/1.ØØ8665/                                              FACTØØ9
      EAB=ABS(Q)                                                        FACTØ1Ø
      CONHLD=2.196771E-Ø3*BWR*SQRT(EAB)                                 FACTØ11
      CONSTE=CONHLD/(BWR+1.Ø)                                           FACTØ12
C----=-SINCE AWR IS GIVEN WITH THE NEUTRON MASS AS UNITY WE ADD ONE ABOVEFACTØ13
C----=-TO CONVERT TO THE CENTER-OF-MASS SYSTEM                          FACTØ14
      ROE=BP*CONSTE                                                     FACTØ15
      S=FLOAT (L)                                                       FACTØ16
      IF(L.LE.Ø)GO TO 1ØØ                                               FACTØ17
      GO TO(11Ø,12Ø,13Ø,14Ø,15Ø),L                                      FACTØ18
  1ØØ PF=ROE                                                            FACTØ19
      SF=Ø.Ø                                                            FACTØ2Ø
      IF(PLOD.LT.2.Ø) GO TO 16Ø                                         FACTØ21
      PS=ROE                                                            FACTØ22
      GO TO 17Ø                                                         FACTØ23
  11Ø ROE2=ROE*ROE                                                      FACTØ24
      DENOM=1.Ø+ROE2                                                    FACTØ25
      PF=ROE2*ROE/DENOM                                                 FACTØ26
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      SF=-1.0/DENOM                                                     FACT027
      IF(PLOD.LT.2.0) GO TO 160                                         FACT028
      PS=ROE-ATAN (ROE)                                                 FACT029
      IF(PS/ROE=0.000001)160,170,170                                    FACT030
  120 ROE2=ROE*ROE                                                      FACT031
      ROE4=ROE2*ROE2                                                    FACT032
      DENOM=3.0*ROE2+ROE4+9.0                                           FACT033
      PF=ROE4*ROE/DENOM                                                 FACT034
      SF=-(18.0+3.0*ROE2)/DENOM                                         FACT035
      IF(PLOD.LT.2.0) GO TO 160                                         FACT036
      PS=ROE-ATAN (3.0*ROE/(3.0-ROE2))                                  FACT037
      IF(PS/ROE=0.000001)160,170,170                                    FACT038
  130 ROE2=ROE*ROE                                                      FACT039
      ROE4=ROE2*ROE2                                                    FACT040
      ROE6=ROE4*ROE2                                                    FACT041
      DENOM=225.0+45.0*ROE2+6.0*ROE4+ROE6                               FACT042
      PF=ROE6*ROE/DENOM                                                 FACT043
      SF=-(675.0+90.0*ROE2+6.0*ROE4)/DENOM                              FACT044
      IF(PLOD.LT.2.0) GO TO 160                                         FACT045
      PS=ROE-ATAN ((15.0*ROE-ROE2*ROE)/(15.0-6.0*ROE2))                 FACT046
      IF(PS/ROE=0.000001)160,170,170                                    FACT047
  140 ROE2=ROE*ROE                                                      FACT048
      ROE4=ROE2*ROE2                                                    FACT049
      ROE6=ROE4*ROE2                                                    FACT050
      ROE8=ROE4*ROE4                                                    FACT051
      DENOM=11025.0+1575.0*ROE2+135.0*ROE4+10.0*ROE6+ROE8               FACT052
      PF=ROE8*ROE/DENOM                                                 FACT053
      IF(PLOD.LT.2.0) GO TO 160                                         FACT054
      SF=-(44100.0+4725.0*ROE2+270.0*ROE4+10.0*ROE6)/DENOM              FACT055
      PS=ROE-ATAN ((105.0*ROE-10.0*ROE2*ROE)/(105.0-45.0                FACT056
     1*ROE2+ROE4))                                                      FACT057
      IF(PS/ROE=0.000001)160,170,170                                    FACT058
  150 ROE2=ROE*ROE                                                      FACT059
      ROE4=ROE2*ROE2                                                    FACT060
      ROE6=ROE4*ROE2                                                    FACT061
      ROE8=ROE4*ROE4                                                    FACT062
      ROE10=ROE6*ROE4                                                   FACT063
      DENOM=893025.0+99225.0*ROE2+6300.0*ROE4+315.0*ROE6                FACT064
     1+15.0*ROE8+ROE10                                                  FACT065
      PF=ROE10*ROE/DENOM                                                FACT066
      SF=4465125.0+396900.0*ROE2+18900.0*ROE4                           FACT067
     1+630.0*ROE6+15.0*ROE8                                             FACT068
      SF=-SF/DENOM                                                      FACT069
      IF(PLOD.LT.2.0) GO TO 160                                         FACT070
      PS=ROE-ATAN ((945.0*ROE-ROE*(105.0*ROE2-ROE4))/(945.0-420.0*ROE2* FACT071
     115.0*ROE4))                                                       FACT072
      IF(PS/ROE.GE.0.000001) GO TO 170                                  FACT073
  160 PS=0.0                                                            FACT074
  170 RETURN                                                            FACT075
      END                                                               FACT076
      SUBROUTINE MOV(I,J)                                               MOV 001
      COMMON/D/ERAN(2,501)                                              MOV 002
      I1=I                                                              MOV 003
      J1=J                                                              MOV 004
      IF(I1.EQ.0)I1=501                                                 MOV 005
      IF(J1.EQ.0)J1=501                                                 MOV 006
      ERAN(1,J1)=ERAN(1,I1)                                             MOV 007
      ERAN(2,J1)=ERAN(2,I1)                                             MOV 008
      RETURN                                                            MOV 009
      END                                                               MOV 010
      SUBROUTINE MOVE(I,J)                                              MOVE001
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      COMMON/C/EX(101),JFLAG(101)                                       MOVE002
      I1=I                                                              MOVE003
      J1=J                                                              MOVE004
      IF(I1.EQ.0)I1=101                                                 MOVE005
      IF(J1.EQ.0)J1=101                                                 MOVE006
      EX(J1)=EX(I1)                                                     MOVE007
      JFLAG(J1)=JFLAG(I1)                                               MOVE008
      RETURN                                                            MOVE009
      END                                                               MOVE010
      FUNCTION KOM(I,J)                                                 KOM 001
      COMMON/D/ERAN(2,501)                                              KOM 002
      I1=I                                                              KOM 003
      J1=J                                                              KOM 004
      IF(I1.EQ.0)I1=501                                                 KOM 005
      IF(J1.EQ.0)J1=501                                                 KOM 006
      EOM=ERAN(1,I1)-ERAN(1,J1)                                         KOM 007
      IF(EOM)100,101,102                                                KOM 008
  100 KOM=-1                                                            KOM 009
      GO TO 103                                                         KOM 010
  101 KOM=0                                                             KOM 011
      GO TO 103                                                         KOM 012
  102 KOM=1                                                             KOM 013
  103 RETURN                                                            KOM 014
      END                                                               KOM 015
      FUNCTION KOME(I,J)
      COMMON/C/EX(101),JFLAG(101)                                       KOME002
      I1=I                                                              KOME003
      J1=J                                                              KOME004
      IF(I1.EQ.0)I1=101                                                 KOME005
      IF(J1.EQ.0)J1=101                                                 KOME006
      EOX=EX(I1)-EX(J1)                                                 KOME007
      IF(EOX)100,101,102                                                KOME008
  100 KOME=-1                                                           KOME009
      GO TO 103                                                         KOME010
  101 KOME=0                                                            KOME011
      GO TO 103                                                         KOME012
  102 KOME=1                                                            KOME013
  103 RETURN                                                            KOME014
      END                                                               KOME015
      SUBROUTINE QIKS (MM,NN,MOVE,COMPAR)                               QIKS0010
CQIKS          ALL-IN-MEMORY SORT PROGRAM                             QIKS0020
C     MM = FIRST SUBSCRIPT                                            QIKS0030
C     NN = LAST SUBSCRIPT  (ARRAY IS IN COMMON)                       QIKS0040
C     MOVE AND COMPAR ARE USER SUPPLIED PROGRAMS                      QIKS0050
      DIMENSION MSAVE(20),NSAVE(20)                                     QIKS0060
      KEYLOC(M,N)=(N+M)/2                                               QIKS0070
      I=0                                                               QIKS0080
      J=0                                                               QIKS0090
      LEVEL  = 0                                                        QIKS0100
      M=MM                                                              QIKS0110
      N=NN                                                              QIKS0120
   35 CONTINUE                                                          QIKS0130
C     TEST FOR ONE OR TWO ITEMS                                       QIKS0140
      IF(N-M-1) 31,51,32                                                QIKS0150
C  32 CONTINUE                                                        QIKS0160
C     PARTITION AND SPREADER GO HERE, SEE BELOW.  RETURN IS TO 8      QIKS0170
C     PUSH DOWN                                                       QIKS0180
    8 LEVEL=LEVEL+1                                                     QIKS0190
C     WORK ON SMALLEST PORTION                                        QIKS0200
      IF ((J-M) - (N-I)) 134, 134, 34                                   QIKS0210
  134 MSAVE(LEVEL) = I                                                  QIKS0220
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   34 MSAVE(LEVEL)=M                                                    QIKS0260
      NSAVE(LEVEL)=J                                                    QIKS0270
      M=I                                                               QIKS0280
      GO TO 35                                                          QIKS0290
   51 IF(COMPAR(M,N))31,31,131                                          QIKS0300
C     SWAP IF ONLY TWO ITEMS ARE OUT OF ORDER                           QIKS0310
  131 CALL MOVE(M,0)                                                    QIKS0320
      CALL MOVE(N,M)                                                    QIKS0330
      CALL MOVE(0,N)                                                    QIKS0340
   31 IF (LEVEL) 151, 150, 151                                          QIKS0350
  150 RETURN                                                            QIKS0360
C     POP UP                                                            QIKS0370
  151 M = MSAVE(LEVEL)                                                  QIKS0380
      N=NSAVE(LEVEL)                                                    QIKS0390
      LEVEL=LEVEL-1                                                     QIKS0400
      GO TO 35                                                          QIKS0410
C     END   MAIN                                                        QIKS0420
C     PARTITION                                                         QIKS0430
   32 I=M                                                               QIKS0440
      J=N                                                               QIKS0450
      KEY=KEYLOC(M,N)                                                   QIKS0460
      CALL MOVE(KEY, 0)                                                 QIKS0470
   54 IF (N - KEY) 17, 1, 17                                            QIKS0480
   17 CALL MOVE(N,KEY)                                                  QIKS0490
    1 CONTINUE                                                          QIKS0500
C     HOLE AT BOTTOM                                                    QIKS0510
      IF(COMPAR(0,I))3,2,2                                              QIKS0520
    2 I=I+1                                                             QIKS0530
      IF (I - J) 1, 4, 1                                                QIKS0540
    3 CALL MOVE(I,J)                                                    QIKS0550
      GO TO 5                                                           QIKS0560
    6 CONTINUE                                                          QIKS0570
C     HOLE AT TOP                                                       QIKS0580
      IF(COMPAR(0,J))5,5,7                                              QIKS0590
    5 J=J-1                                                             QIKS0600
      IF (I - J) 6, 4, 6                                                QIKS0610
    7 CALL MOVE(J,I)                                                    QIKS0620
      GO TO 2                                                           QIKS0630
C   4 CONTINUE                                                          QIKS0640
C     SPREADER GOES HERE                                                QIKS0650
C     END   PARTITION                                                   QIKS0660
C     SPREADER                                                          QIKS0670
    4 CALL MOVE(0,I)                                                    QIKS0680
   12 IF (I - N) 110, 10, 110                                           QIKS0690
  110 I = I + 1                                                         QIKS0700
      IF(COMPAR(0,I))10,12,10                                           QIKS0710
   10 IF (J - M) 108, 8, 108                                            QIKS0720
  108 J = J - 1                                                         QIKS0730
      IF(COMPAR(0,J))8,10,8                                             QIKS0740
C   8 CONTINUE                                                          QIKS0750
C     RETURN TO MAIN PROGRAM                                            QIKS0760
      END                                                               QIKS0770
      SUBROUTINE SPINOR(S,L,XJ)                                         SPNR001
      TERM=0.0                                                          SPNR002
      DENOM=0.0                                                         SPNR003
      IF(S.EQ.0.,.AND.L.EQ.0)GO TO 100                                  SPNR004
      GO TO 101                                                         SPNR0041
C-----FOR S=0 AND S-WAVE RESONANCES SPINS ARE ALL KNOWN HENCE ONE NEEDS SPNR005
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C-----LEVEL=LEVEL INTERFERENCE,                                          SPNR006
  101 IF(S.EQ.0.)GO TO 102                                               SPNR007
      GO TO 103                                                          SPNR0071
  102 XJ=FLOAT (L)                                                       SPNR008
      GO TO 110                                                          SPNR009
  103 XJ1=S+0.5                                                          SPNR010
      XJ2=S-0.5                                                          SPNR011
  111 XL=FLOAT (L)                                                       SPNR012
      IF(XJ1.GT.XL)GO TO 104                                             SPNR013
      GO TO 105                                                          SPNR0131
  104 TERM=TERM+XJ1*(2.0*XL+1.0)                                         SPNR014
      DENOM=DENOM+(2.0*XL+1.0)                                           SPNR015
      GO TO 106                                                          SPNR016
  105 TERM=TERM+XL*(2.0*XJ1+1.0)                                         SPNR017
      DENOM=DENOM+(2.0*XJ1+1.0)                                          SPNR018
  106 IF(XJ2.GT.XL)GO TO 107                                             SPNR019
      GO TO 108                                                          SPNR0191
  107 TERM=TERM+XJ2*(2.0*XL+1.0)                                         SPNR020
      DENOM=DENOM+(2.0*XL+1.0)                                           SPNR021
      GO TO 109                                                          SPNR022
  108 TERM=TERM+XL*(2.0*XJ2+1.0)                                         SPNR023
      DENOM=DENOM+(2.0*XJ2+1.0)                                          SPNR024
  109 XJ=TERM/DENOM                                                      SPNR025
      GO TO 110                                                          SPNR026
  100 XJ=0.0                                                             SPNR027
  110 RETURN                                                             SPNR028
      END                                                                SPNR029
      SUBROUTINE GAUSS(Q,BELTA,DOPE)                                     GAUS001
      COMMON ARAY,IRAY,ERAY,NOT,ZAI,ABN,NER,LFW,EL,EH,LRU,LRF,LANG,NLS,  GAUS002
     1NRES,LN,JN,PENFAR,SHIFAR,SPI,AP,LIS,C,AM,DREF,AREF,IRANGE,NIS,     GAUS003
     3INCROSS,IVSPIN,ELO,TEFF,DELTA,E,AWR                                GAUS004
      DIMENSION ARAY(6,500),IRAY(3,500),ERAY(2,500),NOT(20),ZAI(10),     GAUS005
     1ABN(10),NER(10),LFW(10),EL(10,10),EH(10,10),LRU(10,10),LRF(10,10),GAUS006
     2LANG(10,5,5),NLS(10,10),NRES(10),LN(50),JN(150),PENFAR(500),       GAUS007
     3SHIFAR(500),SPI(10),AP(10),LIS(10),C(10),AM(10),DREF(6),AREF(6)    GAUS008
      DIMENSION ABC(9),WET(9)                                            GAUS009
      DATA ABC/-3.1909932017815 3,-2.2665805845 3184,-1.46855328921667,-0.GAUS010
     17235510187528 4,0.0,0.7235510187528 4,1.46855328921667,2.2665805845 3GAUS011
     2184,3.1909932017815 3/                                             GAUS012
      DATA WET/0.3960697726326E-04,0.4943624275537E-02,0.8847452739438E-GAUS013
     101,0.4326515570026E+00,0.7202352156061E+00,0.4326515570026E+00,0.8GAUS014
     2847452739438E-01,0.4943624275537E-02,0.3960697726326E-04/          GAUS015
      DATA PHIRT/1.772454/                                               GAUS016
      TERM=0.0                                                           GAUS017
      X=BELTA*ABC(9)                                                     GAUS018
      IF(E-X)100,100,101                                                 GAUS019
  101 DO 102 I=1,9                                                       GAUS020
      ABCI=ABC(I)                                                        GAUS021
      WETI=WET(I)                                                        GAUS022
      Z=E+ABCI*BELTA                                                     GAUS023
      CALL SIGMA(Z,AWR,IRANGE)                                           GAUS024
      TERM=TERM+AREF(INCROSS)*WETI                                       GAUS025
  102 CONTINUE                                                           GAUS026
      DOPE=TERM/PHIRT                                                    GAUS027
      GO TO 110                                                          GAUS028
  100 DOPE=0.0                                                           GAUS029
  110 RETURN                                                             GAUS030
      END                                                                GAUS031
      SUBROUTINE GREAT1(F,FINT,NTAB,JMAX,XTAB,PARTS,GOOF,INTER,ERROR,    GRT1001
     1 IERR)                                                             GRT1002
C-----CARRY OUT CONVERGENCE INTEGRATION SCHEME USING TRAPAZOIDAL RULE    GRT1003
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C     AND DOUBLING THE NUMBER OF REGIONS PER SUBINTERVAL FOR EACH       GRT1004
C     ITERATION, ONLY DOUBLE UP IN THOSE INTERVALS THAT HAVE NOT ALREADYGRT1005
C     CONVERGED.                                                        GRT1006
C     F      =SINGLE PRECISION FUNCTION TO BE INTEGRATED                GRT1007
C     FINT   =THE RESULTING INTEGRAL                                    GRT1008
C     NTAB   =NUMBER OF ORDINATES SUPPLIED (THERE ARE N-1 INTERVALS)    GRT1009
C     JMAX   =MAXIMUM ALLOWABLE NUMBER OF ITERATIONS                    GRT1010
C     XTAB   =TABLE OF THE ORDINATE VALUES, RANGE OF INTEGRATION IS     GRT1011
C              FROM XTAB(1) TO XTAB(NTAB)                               GRT1012
C     PARTS  =ARRAY OF DIMENSION NTAB, EQUAL TO THE PARTIAL INTEGRALS   GRT1013
C              OVER EACH OF THE NTAB-1 INTERVALS                        GRT1014
C     GOOF   =ARRAY OF DIMENSION NTAB, EQUAL TO THE NORMAL ERROR IN EACH GRT1015
C              OF THE NTAB-1 INTERVAL.                                  GRT1016
C     INTER  =ARRAY OF DIMENSION NTAB, SEPECIFYING THE NUMBER OF        GRT1017
C              SUBINTERVALS IN EACH INTERVAL                            GRT1018
C     ERROR  =ACCEPTABLE NORMAL ERROR                                   GRT1019
C     IERR   =ERROR INDICATOR, SET TO ZERO IF METHOD CONVERGES, SET TO  GRT1020
C              ONE IF METHOD DOES NOT CONVERGE                          GRT1021
      DIMENSION XTAB(NTAB),PARTS(NTAB),INTER(NTAB),GOOF(NTAB)           GRT1022
C     INITIALIZE VALUE OF THE INTEGRAL                                  GRT1023
      FINT=0.0                                                          GRT1024
C     CALCULATE THE NUMBER OF INTERVALS                                 GRT1025
      NM1=NTAB-1                                                        GRT1026
C     CALCULATE ALLOWABLE ERROR PER INTERVAL                            GRT1027
      ERRN=ERROR/FLOAT(NM1)                                             GRT1028
C     INITIALIZE APPROXIMATION TO INTEGRAL                              GRT1029
      TOTAL=0.0                                                         GRT1030
C     CALCULATE INITIAL APPROXIMATION                                   GRT1031
      DO 10 I=1,NM1                                                     GRT1032
      INTER(I)=1                                                        GRT1033
      PARTS(I)=0.5*(XTAB(I+1)-XTAB(I))*(F(XTAB(I+1))+F(XTAB(I)))        GRT1034
   10 TOTAL=TOTAL+PARTS(I)                                              GRT1035
C     CALCULATE INITIAL ERRORS                                          GRT1036
      DO 15 I=1,NM1                                                     GRT1037
   15 GOOF(I)=PARTS(I)                                                  GRT1038
C     SET UP LOOP OVER ITERATIONS                                       GRT1039
      DO 100 J=1,JMAX                                                   GRT1040
C     SAVE LAST APPROXIMATION                                           GRT1041
      TOTAL1=TOTAL                                                      GRT1042
C     SET UP LOOP OVER INTERVALS                                        GRT1043
      DO 20 I=1,NM1                                                     GRT1044
C     CHECK FOR CONVERGENCE IN THIS INTERVAL                            GRT1045
      IF(ABS(GOOF(I)/TOTAL).LT.ERRN) GO TO 20                           GRT1046
C     CALCULATE DOUBLE INTERVAL                                         GRT1047
      DX=(XTAB(I+1)-XTAB(I))/FLOAT(INTER(I))                            GRT1048
C     DOUBLE NUMBER OF STEPS                                            GRT1049
      INTER(I)=2*INTER(I)                                               GRT1050
C     INITIALIZE CONTRIBUTION TO INTEGRAL                               GRT1051
      REST=0.0                                                          GRT1052
      II=INTER(I)                                                       GRT1053
C     INITIALIZE ORDINATE                                               GRT1054
      XNOW=XTAB(I)+0.5*DX                                               GRT1055
C     SET UP LOOP OVER ORDINATES                                        GRT1056
      DO 30 K=1,II,2                                                    GRT1057
      REST=REST+F(XNOW)                                                 GRT1058
   30 XNOW=XNOW+DX                                                      GRT1059
C     CALCULATE NEXT PARTIAL INTEGRAL                                   GRT1060
      REST=0.5*(PARTS(I)+DX*REST)                                       GRT1061
C     ADD NEW PARTIAL INTEGRAL AND SUBTRACT OLD PARTIAL INTEGRAL        GRT1062
      TOTAL=TOTAL+REST-PARTS(I)                                         GRT1063
C     CALCULATE NEW ERROR AND SET PARTIAL INTEGRAL TO NEW VALUE         GRT1064
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      GOOF(I)=REST-PARTS(I)                                                 GRT1065
      PARTS(I)=REST                                                         GRT1066
   20 CONTINUE                                                              GRT1067
C-----CHECK FOR CONVERGENCE                                                 GRT1068
  100 IF(ABS(1.-TOTAL1/TOTAL).LE.ERROR) GO TO 200                           GRT1069
C-----THE METHOD HAS NOT CONVERGED                                          GRT1070
      FINT=TOTAL                                                            GRT1071
      IERR=1                                                                GRT1072
      RETURN                                                                GRT1073
C-----THE METHOD HAS CONVERGED                                              GRT1074
  200 FINT=TOTAL                                                            GRT1075
      IERR=0                                                                GRT1076
      RETURN                                                                GRT1077
      END                                                                   GRT1078
      SUBROUTINE GREAT2(F,FINT,XTAB,NTAB,ERROR,IERR)                        GRT2001
C-----CARRY OUT CONVERGENCE INTEGRATION SCHEME USING UP TO 200 INTERVALS   GRT2002
C-----WHICH ARE THEN FURTHER SUBDIVIDED UNTIL CONVERGENCE OCCURS OR THE    GRT2003
C-----MAXIMUM ALLOWABLE NUMBER OF ITERATIONS IS EXCEEDED. THE SUBROUTINE   GRT2004
C-----ARGUMENTS ARE DEFINED AS FOLLOWS.....                                 GRT2005
C-----F      =FUNCTION TO BE INTEGRATED.                                    GRT2006
C-----FINT   =THE RESULTING INTEGRAL                                        GRT2007
C-----XTAB   =TABLE OF ORDINATES (INTEGRATION INTERVAL IS FROM XTAB(1) TO   GRT2008
C-----        XTAB(NTAB))                                                   GRT2009
C-----NTAB   =THE LENGTH OF THE XTAB TABLE (NUMBER OF ORDINATES).           GRT2010
C-----ERROR  =ALLOWABLE NORMAL ERROR.                                       GRT2011
C-----IERR   =ERROR INDICATOR SET TO ZERO IF METHOD CONVERGES, SET TO       GRT2012
C-----        ONE IF METHOD DOES NOT CONVERGE.                              GRT2013
C-----        ONE IF METHOD DOES NOT CONVERGE OR TABLE (XTAB) IS TOO LONG   GRT2014
      DIMENSION XTAB(33),PARTS(33),GOOF(33),INTER(33)                       GRT2015
C-----DEFINE THE MAXIMUM ALLOWABLE NUMBER OF ITERATIONS AND THE MAXIMUM     GRT2016
C-----TABLE LENGTH.                                                         GRT2017
      DATA JMAX,NTABMX/20,1000/                                             GRT2018
C-----DETERMINE IF TABLE IS TOO LONG                                        GRT2019
      IF(NTAB.GT.NTABMX) GO TO 100                                          GRT2020
C-----CALL GENERAL INTEGRATION SUBROUTINE.                                  GRT2021
      ZZZ=F(5.0)                                                            GRT20211
      CALL GREAT1(F,FINT,NTAB,JMAX,XTAB,PARTS,GOOF,INTER,ERROR,IERR)        GRT2022
      RETURN                                                                GRT2023
C-----TABLE IS TOO LONG.                                                    GRT2024
  100 IERR=1                                                                GRT2025
      FINT=0.0                                                              GRT2026
      RETURN                                                                GRT2027
      END                                                                   GRT2028
      FUNCTION DOPPLER(X)                                                   DOPL001
      COMMON ARAY,IRAY,ERAY,NOT,ZAI,ABN,NER,LFW,EL,EH,LRU,LRF,LANG,NLS,     DOPL002
     1NRES,LN,JN,PENFAR,SHIFAR,SPI,AP,LIS,C,AM,DREF,AREF,IRANGE,NIS,       DOPL003
     3INCROSS,IVSPIN,ELO,TEFF,DELTA,E,AWR                                   DOPL004
      DIMENSION ARAY(6,500),IRAY(3,500),ERAY(2,500),NOT(20),ZAI(10),        DOPL005
     1ABN(10),NER(10),LFW(10),EL(10,10),EH(10,10),LRU(10,10),LRF(10,10),   DOPL006
     2LANG(10,5,5),NLS(10,10),NRES(10),LN(50),JN(150),PENFAR(500),SHIFAR    DOPL007
     3(500),SPI(10),AP(10),LIS(10),C(10),AM(10),DREF(6),AREF(6)             DOPL008
      Z=(E-X)/DELTA                                                         DOPL009
      Z2=Z*Z                                                                DOPL010
      CALL SIGMA(X,AWR,IRANGE)                                              DOPL011
      DOPPLER =AREF(INCROSS)*EXP(-Z2)/(DELTA*1.772454)                      DOPL012
      RETURN                                                                DOPL013
      END                                                                   DOPL014
      SUBROUTINE GRID(Q,DELTA,NTAB,XTAB)                                    GRID001
      COMMON ARAY,IRAY,ERAY,NOT,ZAI,ABN,NER,LFW,EL,EH,LRU,LRF,LANG,NLS,     GRID002
     1NRES,LN,JN,PENFAR,SHIFAR,SPI,AP,LIS,C,AM,DREF,AREF,IRANGE,NIS,       GRID003
     3INCROSS,IVSPIN,ELO,TEFF,DELTA,E,AWR                                   GRID004
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      DIMENSION ARAY(6,500),IRAY(3,500),ERAY(2,500),NOT(20),ZAI(10),     GRID005
     1ABN(10),NER(10),LFW(10),EL(10,10),EH(10,10),LRU(10,10),LRF(10,10),GRID006
     2LANG(10,5,5),NLS(10,10),NRES(10),LN(50),JN(150),PENFAR(500),       GRID007
     3SHIFAR(500),SPI(10),AP(10),LIS(10),C(10),AM(10),DREF(6),AREF(6)    GRID008
      DIMENSION XTAB(33)                                                 GRID009
      IGNORE=1                                                           GRID010
      N2=NTAB/2                                                          GRID011
      N21=N2+1                                                           GRID012
      N22=N2+2                                                           GRID013
      N3=NTAB-1                                                          GRID014
      XTAB(N21)=Q                                                        GRID015
      DO 1410 I=N22,NTAB                                                 GRID016
      XTAB(I)=XTAB(I-1)*BELTA                                            GRID017
      II=NTAB+1-I                                                        GRID018
      XTAB(II)=XTAB(II+1)*BELTA                                          GRID019
 1410 CONTINUE                                                           GRID020
      DO 1411 I=1,NTAB                                                   GRID021
      XTABI=XTAB(I)                                                      GRID022
      IF(XTABI)1412,1412,1411                                            GRID023
 1412 IGNORE=0                                                           GRID024
 1411 CONTINUE                                                           GRID025
      IF(IGNORE,EQ,0)GO TO 1413                                          GRID026
      GO TO 1414                                                         GRID0261
 1413 XTAB(1)=1.0E-03                                                    GRID027
      DO 1415 I=1,N3                                                     GRID028
      I1=I+1                                                             GRID029
      XTAB(I1)=XTAB(1)*FLOAT (I)*BELTA                                   GRID030
 1415 CONTINUE                                                           GRID031
 1414 RETURN                                                             GRID032
      END                                                                GRID033
      SUBROUTINE SIEVE(E1,G1,E2,G2,M,N,NX,BEFF,BWR)                      SIEV001
      COMMON/C/EX(101),JFLAG(101)                                        SIEV002
      IF(E2.LT.E1)GO TO 101                                              SIEV003
      GO TO 300                                                          SIEV0031
  300 N2=2*N                                                             SIEV004
      DO 1000I=1,100                                                     SIEV005
      JFLAG(I)=2                                                         SIEV006
 1000 CONTINUE                                                           SIEV007
      TEF=BEFF/293.0                                                     SIEV008
      DP=(1.5885E+00)*SQRT (TEF/BWR)                                     SIEV009
C     WHEN MULTIPLIED BY SQRT(E) DP GIVES 5 TIMES CORRESPONDING DELTA    SIEV010
      DP1=DP*SQRT(E1)                                                    SIEV011
      DP2=DP*SQRT (E2)                                                   SIEV012
      DG1=G1/FLOAT (M)                                                   SIEV013
      DG2=G2/FLOAT (M)                                                   SIEV014
      EX(1)=E1                                                           SIEV015
      IF(G1.LT.DP1)GO TO 1001                                            SIEV016
      GO TO 1002                                                         SIEV0161
 1001 JFLAG(1)=1                                                         SIEV017
 1002 ENDIF=ABS (E2-E1)                                                  SIEV018
      NX=1                                                               SIEV019
      DO 100 I=1,N                                                       SIEV020
      XX=E1+DG1*FLOAT (I)                                                SIEV021
      IF(XX.LT.E2)GO TO 107                                              SIEV022
      GO TO 100                                                          SIEV0221
  107 NX=NX+1                                                            SIEV023
      EX(NX)=XX                                                          SIEV024
      IF(G1.LT.DP1)GO TO 1003                                            SIEV025
      GO TO 100                                                          SIEV0251
 1003 JFLAG(NX)=1                                                        SIEV026
  100 CONTINUE                                                           SIEV027
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      DO 200 I=1,N                                                      SIEV028
      XX=E2-DG2*FLOAT (I)                                               SIEV029
      IF(XX.GT.E1)GO TO 108                                             SIEV030
      GO TO 200                                                         SIEV0301
  108 NX=NX+1                                                           SIEV031
      EX(NX)=XX                                                         SIEV032
      IF(G2.LT.DP2)GO TO 1005                                           SIEV033
      GO TO 200                                                         SIEV0331
 1005 JFLAG(NX)=1                                                       SIEV034
  200 CONTINUE                                                          SIEV035
  110 DIFF=(E2-E1)/FLOAT (N2)                                           SIEV036
      IF(DIFF)101,102,102                                               SIEV037
  101 PRINT103                                                          SIEV038
      PRINT2000,E1,E2,DIFF                                              SIEV039
      GO TO 104                                                         SIEV040
  103 FORMAT(32H CALLING SEQUENCE OF SIEVE WRONG)                       SIEV041
 2000 FORMAT(4H E1=E13.6,4H E2=E13.6,6H DIFF=E13.6)                     SIEV042
  102 N21=NX+1                                                          SIEV043
      NN=NX                                                             SIEV044
      N22=N21+N2-2                                                      SIEV045
      NX=N22                                                            SIEV046
      E21=(E1+E2)/2.0                                                   SIEV047
      DP12=DP*SQRT (E21)                                                SIEV048
      E43=E2-E1-((G1+G2)/2.0)                                           SIEV049
      IF(E43.LT.DP12)GO TO 1006                                         SIEV050
      GO TO 1007                                                        SIEV0501
 1006 DO 111 I=N21,N22                                                  SIEV051
      I2=I-NN                                                           SIEV052
      EX(I)=E1+DIFF*FLOAT (I2)                                          SIEV053
      JFLAG(I)=1                                                        SIEV054
  111 CONTINUE                                                          SIEV055
      GO TO 1040                                                        SIEV056
 1007 DO 112 I=N21,N22                                                  SIEV057
      I2=I-NN                                                           SIEV058
      EX(I)=E1+DIFF*FLOAT (I2)                                          SIEV059
      DPTEST=DP*SQRT (EX(I))                                            SIEV060
      IF(EX(I).LE.E21)GO TO 1008                                        SIEV061
      GO TO 1009                                                        SIEV0611
 1008 IF(G1.LT.DPTEST)GO TO 1010                                        SIEV062
      GO TO 112                                                         SIEV0621
 1010 JFLAG(I)=1                                                        SIEV063
      GO TO 112                                                         SIEV064
 1009 IF(G2.LT.DPTEST)GO TO 1011                                        SIEV065
      GO TO 112                                                         SIEV0651
 1011 JFLAG(I)=1                                                        SIEV066
  112 CONTINUE                                                          SIEV067
 1040 DO 113 I=1,NX                                                     SIEV068
      DPF=DP*SQRT (EX(I))                                               SIEV069
      IF(DPF.EQ.0.0)GO TO 113                                           SIEV0691
      TERM=EX(I)/DPF                                                    SIEV070
      IF(TERM.LT.25.)GO TO 114                                          SIEV071
      GO TO 113                                                         SIEV0711
  114 JFLAG(I)=1                                                        SIEV072
  113 CONTINUE                                                          SIEV073
  104 RETURN                                                            SIEV074
      END                                                               SIEV075
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SIGPLOT TEST. IRON DATA.                    Ø 350.    11     2     1.ØE-4
  26056.E+Ø55.36724E+Ø          Ø             Ø          4            Ø
 26054.Ø     Ø.Ø584             Ø             Ø          1            Ø
   4750.       100.E+3          1             2          Ø            Ø
       Ø.          .6          Ø             Ø          2            Ø
 .ØØ1175           Ø.Ø         Ø             Ø         78           13
  -15ØØØ.         .5E+Ø   5ØØ1.ØØØ    5ØØØ.          1.ØØ
    7.83E+3       .5E+Ø   12Ø2.16      12ØØ.E+Ø  2.16
   52.1 E+3       .5E+Ø   21ØØ.E+Ø    21ØØ.E+Ø       .3E+Ø
   71.9 E+3       .5E+Ø   16ØØ.E+Ø    16ØØ.E+Ø       .3E+Ø
   98.5 E+3       .5E+Ø    4ØØ.E+Ø     4ØØ.E+Ø       .3E+Ø
  1Ø2.6 E+3       .5E+Ø   1375.E+Ø    1375.E+Ø       .3E+Ø
  132.  E+3       .5E+Ø   16ØØ.E+Ø    16ØØ.E+Ø       .3E+Ø
  147.  E+3       .5E+Ø   195Ø.E+Ø    195Ø.E+Ø       .3E+Ø
  173.  E+3       .5E+Ø   48ØØ.E+Ø    48ØØ.E+Ø       .3E+Ø
  188.5 E+3       .5E+Ø  38ØØØ.E+Ø   38ØØØ.E+Ø       .3E+Ø
  245.  E+3       .5E+Ø  13ØØØ.E+Ø   13ØØØ.E+Ø       .3E+Ø
  33Ø.  E+3       .5E+Ø   275Ø.E+Ø    275Ø.E+Ø       .3E+Ø
  37Ø.  E+3       .5E+Ø   3ØØØ.E+Ø    3ØØØ.E+Ø       .3E+Ø
   1.175E=3          Ø.           1             Ø          12            2
   9480.            .5       2.Ø4          1.Ø4       1.Ø
  14400.            .5       2.13          1.13       1.Ø
  26056.E+Ø   .9168E+Ø          Ø             Ø          1            Ø
   4750.       100.E+3          1             2          Ø            Ø
      Ø.E+Ø     .6ØE+Ø          Ø             Ø          2            Ø
 .ØØ1187           Ø.Ø         Ø             Ø         9Ø           15
    -4ØØØ.          .5     576.Ø1         575.        1.Ø1
  27ØØØ.            .5    14Ø1.44       14ØØ.          1.44
   74.  E+3       .5E+Ø     425.E+Ø     425.E+Ø        1.E+Ø
   83.6 E+3       .5E+Ø    1ØØØ.E+Ø    1ØØØ.E+Ø        1.E+Ø
  123.5 E+3       .5E+Ø     15Ø.E+Ø     15Ø.E+Ø        1.E+Ø
  13Ø.  E+3       .5E+Ø     5ØØ.E+Ø     5ØØ.E+Ø        1.E+Ø
  141.3 E+3       .5E+Ø    23ØØ.E+Ø    23ØØ.E+Ø        1.E+Ø
  169.  E+3       .5E+Ø     69Ø.E+Ø     69Ø.E+Ø        1.E+Ø
  188.  E+3       .5E+Ø    316Ø.E+Ø    316Ø.E+Ø        1.E+Ø
  22Ø.  E+3       .5E+Ø    13ØØ.E+Ø    13ØØ.E+Ø        1.E+Ø
  243.5 E+3       .5E+Ø     3ØØ.E+Ø     3ØØ.E+Ø        1.E+Ø
  273.  E+3       .5E+Ø    35ØØ.E+Ø    35ØØ.E+Ø        1.E+Ø
  315.  E+3       .5E+Ø    55ØØ.E+Ø    55ØØ.E+Ø        1.E+Ø
  36Ø.  E+3       .5E+Ø    93ØØ.E+Ø    93ØØ.E+Ø        1.E+Ø
  382.  E+3       .5E+Ø   1ØØØØ.E+Ø   1ØØØØ.E+Ø        1.E+Ø
   1.187E=3          Ø.Ø          1             Ø          72           12
   1150.            .5        .616         .Ø52         .564
   2350.            .5      1.ØØØ4         .ØØØ4        1.
  11200.           1.5       1.Ø22         .Ø22         1.
  22700.           1.5       1.1Ø55        .1Ø55        1.
  34100.           1.5       2.346         .346         2.
  36600.            .5       1.43          .43          1.
  38300.           1.5       1.298         .298         1.
  45800.            .5       2.381         .381         2.
  51900.            .5       2.685         .685         2.
  53300.           1.5       1.37          .37          1.
  55ØØØ.            .5       1.1625        .1625        1.
  59ØØØ.            .5       2.74          .74          2.
  26057.E+Ø .Ø217ØØE+Ø          Ø             Ø          1            Ø
   4750.       1ØØ.E+3          1             2          Ø            Ø
         .5          .6          Ø             Ø          2            Ø
 .ØØ1193           Ø.Ø         Ø             Ø         3Ø           5
   3900.           Ø.Ø     241.5         24Ø.          1.5
   6300.           1.Ø     463.73        46Ø.          3.73
  28ØØØ.       1.        3ØØ5.       3ØØØ.          5.
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 40500.          0.   2516.83    2516.          .83
 45500.          1.    269.83     269.          .83
.001193          0.0          1             0          48          8
  1630.          0.      1.08        .25          .83
  4750.          0.     1.086        .256         .83
  7220.          1.     1.753        .923         .83
  7900.          1.     1.146        .316         .83
 12800.          2.     1.336        .506         .83
 13900.          2.     2.426        .776        1.65
 18000.          1.      2.71        1.06        1.65
 21300.          1.      6.92        1.92           5.
 26058.E+0   .0031E+0          0             0           1          0
  4750.       100.E+3          1             2           0          0
     0.E+0     .60E+0          0             2           2          0
 1.200E+3        0.0          0             0           6          1
    -600.          .5        3.57          2.57      1.00
 1.200E+3        0.0          1             0          12          2
   230.          .5     1.00654       .00654          1.
   359.          .5      1.0173        .0173          1.
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TITLE SIGPLOT TEST, IRON DATA,

(Z,A) DESIGNATION OF THE ELEMENT 2,6056E+04 AT,WT/MASS OF NEUTRON 5,5367E+01 NO OF ISOTOPES 4

DATA FOR ISOTOPE NUMBER 1

(Z,A) DESIGNATION OF THE ISOTOPE 2,6054E+04 FRACTIONAL ABUNDANCE 5,8400E-02 NO OF ENERGY RANGES 1
LOWER LIMIT OF THE ENERGY RANGE(EV) 4,7500E+03 UPPER LIMIT(EV) 1,0000E+05 LRU= 1 LRF= 2
NUCLEAR SPIN 0,0000E+00 SCATTERING LENGTH 6,0000E-01 NO OF L-VALUES 2 LIS= 0
CONSTANT USED TO CALCULATE PENETRABILITY 1,1750E-03 SCATTERING LENGTH(A-) 0,0000E+00 ANGULAR MOMENTUM 0 NO OF RESONANCES 13

ERES	SPIN	GTOT	GN	GGAMMA	GF
-1,5000E+04	5,0000E-01	5,0010E+03	5,0000E+03	1,0000E+00	0,0000E+00
7,8300E+03	5,0000E-01	1,2022E+03	1,2000E+03	2,1600E+00	0,0000E+00
5,2100E+04	5,0000E-01	2,1000E+03	2,1000E+03	3,0000E-01	0,0000E+00
7,1900E+04	5,0000E-01	1,6000E+03	1,6000E+03	3,0000E-01	0,0000E+00
9,8500E+04	5,0000E-01	4,0000E+02	4,0000E+02	3,0000E-01	0,0000E+00
1,0260E+05	5,0000E-01	1,3750E+03	1,3750E+03	3,0000E-01	0,0000E+00
1,3200E+05	5,0000E-01	1,6000E+03	1,6000E+03	3,0000E-01	0,0000E+00
1,4700E+05	5,0000E-01	1,9500E+03	1,9500E+03	3,0000E-01	0,0000E+00
1,7300E+05	5,0000E-01	4,8000E+03	4,8000E+03	3,0000E-01	0,0000E+00
1,8850E+05	5,0000E-01	3,8000E+04	3,8000E+04	3,0000E-01	0,0000E+00
2,4500E+05	5,0000E-01	1,3000E+04	1,3000E+04	3,0000E-01	0,0000E+00
3,3000E+05	5,0000E-01	2,7500E+03	2,7500E+03	3,0000E-01	0,0000E+00
3,7000E+05	5,0000E-01	3,0000E+03	3,0000E+03	3,0000E-01	0,0000E+00

CONSTANT USED TO CALCULATE PENETRABILITY 1,1750E-03 SCATTERING LENGTH(A-) 0,0000E+00 ANGULAR MOMENTUM 1 NO OF RESONANCES 2

ERES	SPIN	GTOT	GN	GGAMMA	GF
9,4800E+03	5,0000E-01	2,0400E+00	1,0400E+00	1,0000E+00	0,0000E+00
1,4400E+04	5,0000E-01	2,1300E+00	1,1300E+00	1,0000E+00	0,0000E+00

DATA FOR ISOTOPE NUMBER 2

(Z,A) DESIGNATION OF THE ISOTOPE 2,6056E+04 FRACTIONAL ABUNDANCE 9,1680E-01 NO OF ENERGY RANGES 1
LOWER LIMIT OF THE ENERGY RANGE(EV) 4,7500E+03 UPPER LIMIT(EV) 1,0000E+05 LRU= 1 LRF= 2
NUCLEAR SPIN 0,0000E+00 SCATTERING LENGTH 6,0000E-01 NO OF L-VALUES 2 LIS= 0
CONSTANT USED TO CALCULATE PENETRABILITY 1,1870E-03 SCATTERING LENGTH(A-) 0,0000E+00 ANGULAR MOMENTUM 0 NO OF RESONANCES 15

ERES	SPIN	GTOT	GN	GGAMMA	GF
-4.0000E+03	5.0000E-01	5.7601E+02	5.7500E+02	1.0100E+00	0.0000E+00
2.7700E+04	5.0000E-01	1.4014E+03	1.4000E+03	1.4400E+00	0.0000E+00
7.4000E+04	5.0000E-01	4.2500E+02	4.2500E+02	1.0000E+00	0.0000E+00
8.3600E+04	5.0000E-01	1.0000E+03	1.0000E+03	1.0000E+00	0.0000E+00
1.2350E+05	5.0000E-01	1.5000E+02	1.5000E+02	1.0000E+00	0.0000E+00
1.3000E+05	5.0000E-01	5.0000E+02	5.0000E+02	1.0000E+00	0.0000E+00
1.4130E+05	5.0000E-01	2.3000E+03	2.3000E+03	1.0000E+00	0.0000E+00
1.6900E+05	5.0000E-01	6.9000E+02	6.9000E+02	1.0000E+00	0.0000E+00
1.8800E+05	5.0000E-01	3.1600E+03	3.1600E+03	1.0000E+00	0.0000E+00
2.2000E+05	5.0000E-01	1.3000E+03	1.3000E+03	1.0000E+00	0.0000E+00
2.4350E+05	5.0000E-01	3.0000E+02	3.0000E+02	1.0000E+00	0.0000E+00
2.7300E+05	5.0000E-01	3.5000E+03	3.5000E+03	1.0000E+00	0.0000E+00
3.1500E+05	5.0000E-01	5.5000E+03	5.5000E+03	1.0000E+00	0.0000E+00
3.6000E+05	5.0000E-01	9.3000E+03	9.3000E+03	1.0000E+00	0.0000E+00
3.8200E+05	5.0000E-01	1.0000E+04	1.0000E+04	1.0000E+00	0.0000E+00

CONSTANT USED TO CALCULATE PENETRABILITY 1.1870E-03 SCATTERING LENGTH(A-) 0.0000E+00 ANGULAR MOMENTUM 1 NO OF RESONANCES 12

ERES	SPIN	GTOT	GN	GGAMMA	GF
1.1500E+03	5.0000E-01	6.1600E-01	5.2000E-02	5.6400E-01	0.0000E+00
2.3500E+03	5.0000E-01	1.0004E+00	4.0000E-04	1.0000E+00	0.0000E+00
1.1200E+04	1.5000E+00	1.0220E+00	2.2000E-02	1.0000E+00	0.0000E+00
2.2700E+04	1.5000E+00	1.1055E+00	1.0550E-01	1.0000E+00	0.0000E+00
3.4100E+04	1.5000E+00	2.3460E+00	3.4600E-01	2.0000E+00	0.0000E+00
3.6600E+04	5.0000E-01	1.4300E+00	4.3000E-01	1.0000E+00	0.0000E+00
3.8300E+04	1.5000E+00	1.2980E+00	2.9800E-01	1.0000E+00	0.0000E+00
4.5800E+04	5.0000E-01	2.3810E+00	3.8100E-01	2.0000E+00	0.0000E+00
5.1900E+04	5.0000E-01	2.6850E+00	6.8500E-01	2.0000E+00	0.0000E+00
5.3300E+04	1.5000E+00	1.3700E+00	3.7000E-01	1.0000E+00	0.0000E+00
5.5000E+04	5.0000E-01	1.1625E+00	1.6250E-01	1.0000E+00	0.0000E+00
5.9000E+04	5.0000E-01	2.7400E+00	7.4000E-01	2.0000E+00	0.0000E+00

DATA FOR ISOTOPE NUMBER 3

(Z,A) DESIGNATION OF THE ISOTOPE 2.6057E+04 FRACTIONAL ABUNDANCE 2.1700E-02 NO OF ENERGY RANGES 1
LOWER LIMIT OF THE ENERGY RANGE(EV) 4.7500E+03 UPPER LIMIT(EV) 1.0000E+05 LRU= 1 LRF= 2
NUCLEAR SPIN 5.0000E-01 SCATTERING LENGTH 6.0000E-01 NO OF L-VALUES 2 LIS= 0
CONSTANT USED TO CALCULATE PENETRABILITY 1.1930E-03 SCATTERING LENGTH(A-) 0.0000E+00 ANGULAR MOMENTUM 0 NO OF RESONANCES 5

ERES	SPIN	GTOT	GN	GGAMMA	GF
3.9000E+03	0.0000E+00	2.4150E+02	2.4000E+02	1.5000E+00	0.0000E+00
6.3000E+03	1.0000E+00	4.6373E+02	4.6000E+02	3.7300E+00	0.0000E+00
2.8000E+04	1.0000E+00	3.0050E+03	3.0000E+03	5.0000E+00	0.0000E+00
4.0500E+04	0.0000E+00	2.5168E+03	2.5160E+03	8.3000E-01	0.0000E+00
4.5500E+04	1.0000E+00	2.6983E+02	2.6900E+02	8.3000E-01	0.0000E+00

CONSTANT USED TO CALCULATE PENETRABILITY 1,1930E-03 SCATTERING LENGTH(A-) 0,0000E+00 ANGULAR MOMENTUM 1 NO OF RESONANCES 8

ERES	SPIN	GTOT	GN	GGAMMA	GF
1,6300E+03	0,0000E+00	1,0800E+00	2,5000E-01	8,3000E-01	0,0000E+00
4,7500E+03	0,0000E+00	1,0860E+00	2,5600E-01	8,3000E-01	0,0000E+00
7,2200E+03	1,0000E+00	1,7530E+00	9,2300E-01	8,3000E-01	0,0000E+00
7,9000E+03	1,0000E+00	1,1460E+00	3,1600E-01	8,3000E-01	0,0000E+00
1,2800E+04	2,0000E+00	1,3360E+00	5,0600E-01	8,3000E-01	0,0000E+00
1,3900E+04	2,0000E+00	2,4260E+00	7,7600E-01	1,6500E+00	0,0000E+00
1,8000E+04	1,0000E+00	2,7100E+00	1,0600E+00	1,6500E+00	0,0000E+00
2,1300E+04	1,0000E+00	6,9200E+00	1,9200E+00	5,0000E+00	0,0000E+00

DATA FOR ISOTOPE NUMBER 4

(Z,A) DESIGNATION OF THE ISOTOPE 2,6058E+04 FRACTIONAL ABUNDANCE 3,1000E-03 NO OF ENERGY RANGES 1
LOWER LIMIT OF THE ENERGY RANGE(EV) 4,7500E+03 UPPER LIMIT(EV) 1,0000E+05 LRU= 1 LRF= 2
NUCLEAR SPIN 0,0000E+00 SCATTERING LENGTH 6,0000E-01 NO OF L-VALUES 2 LIS= 0
CONSTANT USED TO CALCULATE PENETRABILITY 1,2000E-03 SCATTERING LENGTH(A-) 0,0000E+00 ANGULAR MOMENTUM 0 NO OF RESONANCES 1

ERES	SPIN	GTOT	GN	GGAMMA	GF
-6,0000E+02	5,0000E-01	3,5700E+00	2,5700E+00	1,0000E+00	0,0000E+00

CONSTANT USED TO CALCULATE PENETRABILITY 1,2000E-03 SCATTERING LENGTH(A-) 0,0000E+00 ANGULAR MOMENTUM 1 NO OF RESONANCES 2

ERES	SPIN	GTOT	GN	GGAMMA	GF
2,3000E+02	5,0000E-01	1,0065E+00	6,5400E-03	1,0000E+00	0,0000E+00
3,5900E+02	5,0000E-01	1,0173E+00	1,7300E-02	1,0000E+00	0,0000E+00

CROSS-SECTIONS AT THERMAL ENERGY

NEUTRON ENERGY(EV)	SIGNN	SIGCAP	SIGF	SIGT	SIGNNMULT	SIGTMULT
2,530000E-02	1,336513E+01	2,523085E+00	0,000000E+00	1,588822E+01	1,137373E+01	1,389682E+01

NEUTRON ENERGY(EV)	SIGNN	SIGCAP	SIGF	SIGT	SIGNNMULT	SIGTMULT

4,750000E+03	6,785771E+00	5,602725E-01	0,000000E+00	7,346044E+00	5,693696E+00	6,253968E+00
4,981865E+03	6,502255E+00	5,412982E-03	0,000000E+00	6,507667E+00	5,432315E+00	5,437728E+00
5,137500E+03	6,465403E+00	5,973383E-03	0,000000E+00	6,471377E+00	5,410551E+00	5,416524E+00
5,213730E+03	6,460483E+00	6,343325E-03	0,000000E+00	6,466826E+00	5,413359E+00	5,419702E+00
5,525000E+03	6,580239E+00	8,971672E-03	0,000000E+00	6,589210E+00	5,570369E+00	5,579341E+00
5,836270E+03	7,275194E+00	1,643329E-02	0,000000E+00	7,291627E+00	6,323456E+00	6,339890E+00
5,912500E+03	7,693594E+00	2,030699E-02	0,000000E+00	7,713901E+00	6,760468E+00	6,780775E+00
6,068135E+03	9,350730E+00	3,432255E-02	0,000000E+00	9,385053E+00	8,444930E+00	8,479252E+00
6,300000E+03	1,367890E+01	6,217415E-02	0,000000E+00	1,374108E+01	1,253046E+01	1,259264E+01
6,530000E+03	1,153816E+01	3,519009E-02	0,000000E+00	1,157335E+01	1,013255E+01	1,016774E+01
6,531865E+03	1,151748E+01	3,498536E-02	0,000000E+00	1,155247E+01	1,011165E+01	1,014663E+01
6,760000E+03	1,039641E+01	2,128743E-02	0,000000E+00	1,041770E+01	9,013376E+00	9,034663E+00
6,763730E+03	1,039735E+01	2,119639E-02	0,000000E+00	1,041855E+01	9,014939E+00	9,036135E+00
6,990000E+03	1,128880E+01	1,963277E-02	0,000000E+00	1,130843E+01	9,945808E+00	9,965440E+00
7,218247E+03	1,414936E+01	3,261779E-01	0,000000E+00	1,447554E+01	1,287594E+01	1,320212E+01
7,219123E+03	1,466805E+01	7,810764E-01	0,000000E+00	1,544913E+01	1,339505E+01	1,417612E+01
7,220000E+03	1,552657E+01	1,539844E+00	0,000000E+00	1,706642E+01	1,425398E+01	1,579382E+01
7,220876E+03	1,469754E+01	7,810644E-01	0,000000E+00	1,547860E+01	1,342535E+01	1,420642E+01
7,221753E+03	1,420473E+01	3,263050E-01	0,000000E+00	1,453104E+01	1,293296E+01	1,325927E+01
7,228920E+03	1,399226E+01	3,789944E-02	0,000000E+00	1,403016E+01	1,272393E+01	1,276183E+01
7,372500E+03	1,656123E+01	2,761971E-02	0,000000E+00	1,658885E+01	1,538890E+01	1,541652E+01
7,525000E+03	1,996881E+01	3,279241E-02	0,000000E+00	2,000160E+01	1,897588E+01	1,900867E+01
7,677500E+03	2,328673E+01	3,707367E-02	0,000000E+00	2,332380E+01	2,256588E+01	2,260295E+01
7,830000E+03	2,511229E+01	3,806536E-02	0,000000E+00	2,515035E+01	2,470823E+01	2,474630E+01
7,847500E+03	2,517165E+01	3,794436E-02	0,000000E+00	2,520960E+01	2,480225E+01	2,484019E+01
7,865000E+03	2,519768E+01	3,787235E-02	0,000000E+00	2,523555E+01	2,486198E+01	2,489986E+01
7,882500E+03	2,519088E+01	3,846959E-02	0,000000E+00	2,522935E+01	2,488779E+01	2,492626E+01
7,898854E+03	2,523834E+01	2,589722E-01	0,000000E+00	2,549731E+01	2,496461E+01	2,522358E+01
7,899427E+03	2,536322E+01	5,920254E-01	0,000000E+00	2,595524E+01	2,509050E+01	2,568252E+01
7,900000E+03	2,557363E+01	1,147331E+00	0,000000E+00	2,672097E+01	2,530192E+01	2,644925E+01
7,900573E+03	2,536117E+01	5,920071E-01	0,000000E+00	2,595318E+01	2,509046E+01	2,568247E+01
7,901146E+03	2,523234E+01	2,589441E-01	0,000000E+00	2,549129E+01	2,496264E+01	2,522158E+01
8,295000E+03	1,919762E+01	2,253041E-02	0,000000E+00	1,922015E+01	1,923586E+01	1,925839E+01
8,690000E+03	1,335408E+01	1,199169E-02	0,000000E+00	1,336607E+01	1,338078E+01	1,339278E+01
9,085000E+03	1,020244E+01	7,076996E-03	0,000000E+00	1,020951E+01	1,003792E+01	1,004499E+01
9,477960E+03	9,323108E+00	8,350098E-01	0,000000E+00	1,015812E+01	9,083403E+00	9,918413E+00
9,478980E+03	1,061444E+01	2,081131E+00	0,000000E+00	1,269557E+01	1,037469E+01	1,245582E+01
9,480000E+03	1,277854E+01	4,159574E+00	0,000000E+00	1,693811E+01	1,253810E+01	1,669768E+01
9,481020E+03	1,061935E+01	2,081001E+00	0,000000E+00	1,270035E+01	1,037823E+01	1,245924E+01
9,482040E+03	9,318955E+00	8,350569E-01	0,000000E+00	1,015401E+01	9,077790E+00	9,912847E+00
9,910000E+03	7,313152E+00	3,242707E-03	0,000000E+00	7,316394E+00	7,021110E+00	7,024352E+00
1,034000E+04	6,564929E+00	2,419987E-03	0,000000E+00	6,567349E+00	6,241760E+00	6,244180E+00
1,077000E+04	6,031694E+00	1,925410E-03	0,000000E+00	6,033619E+00	5,690138E+00	5,692064E+00
1,119898E+04	5,660840E+00	1,862921E+00	0,000000E+00	7,523761E+00	5,309128E+00	7,172049E+00
1,119949E+04	5,720218E+00	4,654958E+00	0,000000E+00	1,037518E+01	5,368506E+00	1,002346E+01
1,120000E+04	5,830226E+00	9,308277E+00	0,000000E+00	1,513850E+01	5,478464E+00	1,478674E+01
1,120051E+04	5,735508E+00	4,655149E+00	0,000000E+00	1,039066E+01	5,383695E+00	1,003884E+01
1,120102E+04	5,672045E+00	1,863079E+00	0,000000E+00	7,535124E+00	5,320232E+00	7,183311E+00
1,160000E+04	5,320346E+00	1,381587E-03	0,000000E+00	5,321728E+00	4,964007E+00	4,965388E+00
1,200000E+04	5,062646E+00	1,213998E-03	0,000000E+00	5,063860E+00	4,705030E+00	4,706244E+00
1,240000E+04	4,838706E+00	1,098311E-03	0,000000E+00	4,839804E+00	4,482188E+00	4,483286E+00
1,279866E+04	4,802337E+00	2,700907E-01	0,000000E+00	5,072428E+00	4,449188E+00	4,719278E+00
1,279933E+04	5,047677E+00	6,737919E-01	0,000000E+00	5,721469E+00	4,694669E+00	5,368461E+00
1,280000E+04	5,459894E+00	1,346754E+00	0,000000E+00	6,806648E+00	5,106218E+00	6,452972E+00
1,280067E+04	5,051586E+00	6,737859E-01	0,000000E+00	5,725372E+00	4,697238E+00	5,371024E+00
1,280134E+04	4,804717E+00	2,701045E-01	0,000000E+00	5,074822E+00	4,450510E+00	4,720614E+00
1,307500E+04	4,513546E+00	9,679320E-04	0,000000E+00	4,514514E+00	4,162595E+00	4,163563E+00
1,335000E+04	4,394794E+00	9,259876E-04	0,000000E+00	4,395720E+00	4,047085E+00	4,048011E+00

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C      PROGRAM SIGMA2(INPUT,OUTPUT)                                          SIG2001
       COMMON/D/ERAN(2,501)                                                  SIG2002
       COMMON/C/EX(101),JFLAG(101)                                           SIG2003
       COMMON/E/XMIN(6),XMAX(6),XREF(6)                                      SIG2004
       COMMON ARAY,IRAY,ERAY,NOT,ZAI,ABN,NER,LFW,EL,EH,LRU,LRF,LANG,NLS,     SIG2005
      1NRES,LN,JN,PENFAR,SHIFAR,SPI,AP,AWRI,AM,DREF,AREF,BREF,IRANGE,NIS,SIG2006
      3INCROSS,IVSPIN,ELO,TEFF,DELTA,E,AWR                                   SIG2007
       EXTERNAL MOV,KOM                                                      SIG2008
       EXTERNAL MOVE,KOME                                                    SIG2009
       EXTERNAL DOPPLER                                                      SIG2010
       DIMENSION ARAY(6,500),IRAY(3,500),ERAY(2,500),NOT(20),ZAI(10),        SIG2011
      1ABN(10),NER(10),LFW(10),EL(10,10),EH(10,10),LRU(10,10),LRF(10,10),SIG2012
      2LANG(10,5,5),NLS(10,10),NRES(10),LN(50),JN(150),PENFAR(500),         SIG2013
      3SHIFAR(500),SPI(10),AP(10),AWRI(10),AM(10),DREF(6),AREF(6),BREF(6,SIG2014
      410)                                                                   SIG2015
       DIMENSION TITLE(7),XTAB(33)                                           SIG2016
       DATA MAXPTS,MAXRES,ETHERM/2000,100,0.253E-01/                         SIG2017
C-----THIS A PROGRAM TO CALCULATE SCATTERING,CAPTURE,FISSION AND TOTAL       SIG2018
C-----CROSS-SECTIONS EITHER AS A SUM OF BREIT-WIGNER TERMS OR WITH A         SIG2019
C-----MULTI-LEVEL FORMULA TAKING INTO ACCOUNT LEVEL-LEVEL INTERFERENCE,      SIG2020
C-----THIS PROGRAM MODIFIED ON 30,7,1970 TO INCLUDE NEW FORMAT CHANGES       SIG2021
C-----GIVING INDIVIDUAL ISOTOPE MASSES AND TWO DIFFERENT NUCLEAR RADII,     SIG2022
C-----THESE FORMAT CHANGES CORRESPOND TO ENDF/B VERSION II DATA.             SIG2023
C-----RUNS ON CDC-6600 AND PDP-10                                           SIG20231
C      1111111111111111111111111111111111111111111111111111111111111111111SIG2024
            READ1,(TITLE(I),I=1,7),IDPL,TEFF,NTAB,INCROSS,ERROR,IVSPIN      SIG2025
C---=-IDPL=1 IF DOPPLER BROADENED CROSS-SECTIONS ARE DESIRED,ELSE IDPL=0     SIG2026
C-----TEFF=EFFECTIVE TEMPERATURE OF THE TARGET IN DEGREES KELVIN,            SIG2027
C----=NTAB=NUMBER OF PIVOT POINTS TO BE USED IN EVALUATING THE DOPPLER       SIG2028
C----=BROADENED CROSS-SECTION, TO GET THE DOPPLER BROADENED CROSS-SECTIO     SIG2029
C-----N AT EVERY ENERGY E WE TAKE THE INTERVAL E-N2*DELTA TO E+N2*DELTA      SIG2030
C-----FOR THE INTEGRAL WHERE N2=NTAB/2 AND DELTA IS THE DOPPLER CONSTANT     SIG2031
C----=NTAB=11 OR SO SHOULD SUFFICE FOR ALL CASES, NTAB= ODD INTEGER,         SIG2032
C----=ERROR=  IF THE RELATIVE ERROR BETWEEN TWO SUCCESSIVE ITERATIONS       SIG2033
C---=-OF THE DOPPLER INTEGRAL IS LESS THAN ERROR THE INTEGRATION ROUTINE    SIG2034
C---=-ASSUMES THAT THE INTEGRAL HAS CONVERGED AND IT EXITS, TYPICAL         SIG2035
C---=-VALUES COULD BE=1.0E-04, HOWEVER IT IS RECOMMENDED THAT THE USER      SIG2036
C---=-EXERCISE HIS JUDGEMENT IN FEEDING THIS VALUE COMMENSURATE WITH THE    SIG2037
C---=-ACCURACY OF THE FINAL RESULT DESIRED AND COMPUTER TIME AVAILABLE,     SIG2038
C----=-IN PRACTICE IT IS FOUND THAT THE SPINS OF ONLY A FEW RESONANCES AR   SIG2039
C----=KNOWN AS A RESULT OF DIRECT MEASUREMENT WHILE REST OF THE RESONANC    SIG2040
C-----ES ARE ASSIGNED AN AVERAGE SPIN WHICH IS EQUAL TO THE AVERAGE OF      SIG2041
C---=-ALL POSSIBLE SPINS  FOR THE PARTICULAR PARTIAL WAVE, THIS AVERAGE     SIG2042
C----=SPIN IS CALCULATED FOR A GIVEN TARGET NUCLEUS SPIN AND A GIVEN L-VA   SIG2043
C----=-IN THIS PROGRAM IN CALCULATING THE SCATTERING CROSS-SECTION WITH     SIG2044
C----=-LEVEL-LEVEL INTERFERENCE, RESONANCES OF A PARTICULAR SPIN VALUE      SIG2045
C---=-INTERFERE AMONGST THEMSELVES. HOWEVER,IF A GROUP OF RESONANCES HAS    SIG2046
C---=-SPIN EQUAL TO THE AVERAGE SPIN ,THEIR MUTUAL INTERFERENCE TERM IS     SIG2047
C----=-SET EQUAL TO ZERO,IF IT IS DESIRED TO INCLUDE THIS MUTUAL INTERFER   SIG2048
C----=-TERM PUNCH A 1 IN COLUMN 65 ELSE PUNCH A 0,                          SIG2049
                    PRINT33                                                SIG2050
                    PRINT25                                                SIG2051
                    PRINT24,(TITLE(I),I 1,7)                               SIG2052
       PRINT25                                                             SIG2053
    1 FORMAT(7A4,2X,I5,F5.1,2I5,E10.4,I5)                                  SIG2054
      IF(IDPL.EQ.1)GO TO 1011                                              SIG2055
      GO TO 1012                                                           SIG20551
 1011 PRINT25                                                              SIG2056
      PRINT30,TEFF,NTAB,ERROR,INCROSS                                      SIG2057
      PRINT25                                                              SIG2058
      GO TO 1013                                                           SIG2059
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 1012 CONTINUE                                                          SIG2060
C     22222222222222222222222222222222222222222222222222222222222222SIG2061
 1013                 READ3,ZA,AWR,NOT(1),NOT(2),NIS,NOT(3)             SIG2062
C----=ZA=(Z,A)DESIGNATION OF MATERIAL,AWR=AT.WT/NEUTRON MASS,NIS=NO OF  SIG2063
C-----ISOTOPES                                                          SIG2064
                     PRINT17,ZA,AWR,NIS                                 SIG2065
      PRINT25                                                           SIG2066
      J1=1                                                              SIG2067
      JFID=1                                                            SIG2068
      DO 101 I=1,NIS                                                    SIG2069
      NRANGE=1                                                          SIG2070
C     33333333333333333333333333333333333333333333333333333333333333SIG2071
      PRINT25                                                           SIG2072
                     PRINT18,I                                          SIG2073
      PRINT25                                                           SIG2074
                     READ3,ZAI(I),ABN(I),NOT(4),LFW(I),NER(I),NOT(5)    SIG2075
C----=ZAI(I)=(Z,A) DESIGNATION OF ITH ISOTOPE ABN(I)=WT FRACTION OF ITH SIG2076
C-----ISOTOPE LFW=1 FISSION WIDTHS ARE GIVEN,=0 FISSION WIDTHS NOT GIVENSIG2077
C-----NER(I)=NO OF ENERGY RANGES USED                                   SIG2078
                     PRINT19,ZAI(I),ABN(I),NER(I)                       SIG2079
      NERI=NER(I)                                                       SIG2080
      J2=1                                                              SIG2081
C     44444444444444444444444444444444444444444444444444444444444444SIG2082
  106                READ3,EL(I,J2),EH(I,J2),LRU(I,J2),LRF(I,J2),NOT(6),NOSIG2083
     1T(7)                                                              SIG2084
C-----EL=LOWER ENERGY LIMIT OF A RANGE, EH=UPPER LIMIT OF A RANGE       SIG2085
C-----LRU=1 RESOLVED RESONANCE PARAMETERS,LRU=2 UNRESOLVED  PARAMTRS    SIG2086
C-----LRF INDICATES PARTICULAR TYPE OF RESONANCE FORMULA TO BE USED     SIG2087
                     PRINT20,EL(I,J2),EH(I,J2),LRU(I,J2),LRF(I,J2)      SIG2088
      LRUIJ=LRU(I,J2)                                                   SIG2089
      IF(LRUIJ-1)127,128,1010                                           SIG2090
  127 PRINT10                                                           SIG2091
      GO TO 130                                                         SIG2092
  128 NMOM=1                                                            SIG2093
C     55555555555555555555555555555555555555555555555555555555555555SIG2094
                     READ3,SPI(I),AP(I),NOT(7),NOT(8),NLS(I,J2),NOT(9)  SIG2095
C----=SPI(I)=SPIN OF THE I-TH ISOTOPE,AP(I)=A* SPIN DEPENDENT SCATTERINGSIG2096
C-----LENGTH IN UNITS OF 1.0E-12CM,AM(I)=A-, FOR SPIN INDEPENDENCEAM(I)=SIG2097
C----=NLS=NUMBER OF L-VALUES                                            SIG2098
                     PRINT21,SPI(I),AP(I),NLS(I,J2)                     SIG2099
      JL=1                                                              SIG2100
C     66666666666666666666666666666666666666666666666666666666666666SIG2101
  104             READ3,AWRI(I),AM(I),LANG(I,J2,JL),NOT(10),NRS6X,NRS   SIG2102
C----=AWRI(I)=MASS OF THE I-TH ISOTOPE IN UNITS OF NEUTRON MASS,AM=SEE ASIG2103
C----=LANG=L-VALUE OF THE ANGULAR MOMENTUM,NRS=NUMBER OF RESONANCES.    SIG2104
                     PRINT22,AWRI(I),AM(I),LANG(I,J2,JL),NRS            SIG2105
      NMOM=NMOM+1                                                       SIG2106
      J3=J1+(NRS-1)                                                     SIG2107
C     77777777777777777777777777777777777777777777777777777777777777SIG2108
                     READ4,((ARAY(K,J),K=1,6),J=J1,J3)                  SIG2109
C     THIS IS WHERE THE RESONANCE PARAMETERS ARE READ IN, ARAY(1,J)=ERESSIG2110
C     IN EV, ARAY(2,J)=J VALUE,ARAY(3,J)=TOTAL GAMMA, ARAY(4,J)=NEUTRON SIG2111
C     WIDTH,ARAY(5,J)=GAMMA GAMMA, ARAY(6,J)=FISSION WIDTH, ALL WIDTHS ISIG2112
C     N EV.                                                             SIG2113
      PRINT25                                                           SIG2114
                     PRINT23                                            SIG2115
                     PRINT26,((ARAY(K,J),K=1,6),J=J1,J3)                SIG2116
      PRINT25                                                           SIG2117
      DO 102 J=J1,J3                                                    SIG2118
      IRAY(1,J)=LANG(I,J2,JL)                                           SIG2119
      IRAY(2,J)=NRANGE                                                  SIG2120
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      IRAY(3,J)=I                                                       SIG2121
      ERAY(1,J)=SPI(I)                                                  SIG2122
      ERAY(2,J)=AP(I)                                                   SIG2123
  102 CONTINUE                                                          SIG2124
      J1=J1+NRS                                                         SIG2125
      JL=JL+1                                                           SIG2126
      IF(NMOM-NLS(I,J2))104,104,103                                     SIG2127
  103 NRANGE=NRANGE+1                                                   SIG2128
      J2=J2+1                                                           SIG2129
      IF(NRANGE-NERI)106,106,1010                                       SIG2130
 1010 NRES(I)=J1-JFID                                                   SIG2131
      JFID=J1                                                           SIG2132
  101 CONTINUE                                                          SIG2133
      NTOTAL=J1-1                                                       SIG2134
      SCALE=1.0E+00                                                     SIG2135
      PHI=3.14159265                                                    SIG2136
    3 FORMAT(2E11.4,4I11)                                               SIG2137
    4 FORMAT(6E11.4)                                                    SIG2138
    5 FORMAT(8E11.4,3I10)                                               SIG2139
    6 FORMAT(2X,2E11.4)                                                 SIG2140
    7 FORMAT(107H NEUTRON ENERGY( EV)    SIGNN          SIGCAP          SSIG2141
     1IGF          SIGT          SIGNNMULT      SIGTMULT  )            SIG2142
    8 FORMAT(2X,7E15.6)                                                 SIG2143
    9 FORMAT(10X,2E20.6)                                                SIG2144
   10 FORMAT(20H ERROR IN INPUT DATA)                                   SIG2145
   11 FORMAT(10X,2I10)                                                  SIG2146
   12 FORMAT(10X,6I10)                                                  SIG2147
   14 FORMAT(53H CROSS-SECTIONS CALCULATED WITHOUT DOPPLER BROADENING)  SIG2149
   15 FORMAT(49H CROSS-SECTIONS CALCULTED WITH DOPPLER BROADENING)      SIG2150
   16 FORMAT(15H NEUTRON ENERGYE15.6)                                   SIG2148
   17 FORMAT(33H (Z,A) DESIGNATION OF THE ELEMENTE11.4,22H AT.WT/MASS OFSIG2151
     1 NEUTRONE11.4,15H NO OF ISOTOPESI5)                               SIG2152
   18 FORMAT(24H DATA FOR ISOTOPE NUMBERI5)                             SIG2153
   19 FORMAT(33H (Z,A) DESIGNATION OF THE ISOTOPEE11.4,21H FRACTIONAL ABSIG2154
     1UNDANCEE11.4,20H NO OF ENERGY RANGESI5)                           SIG2155
   20 FORMAT(36H LOWER LIMIT OF THE ENERGY RANGE(EV)E11.4,18H   UPPER LISIG2156
     1MIT(EV)E11.4,6H  LRU=I5,6H  LRF=I5)                               SIG2157
   21 FORMAT(13H NUCLEAR SPINE11.4,18H SCATTERING LENGTHE11.4,15H NO OF SIG2158
     1L-VALUESI5)                                                       SIG2159
   22 FORMAT(45H MASS OF THE ISOTOPE IN UNITS OF NEUTRON MASSE11.4,22H SSIG2160
     1CATTERING LENGTH(A-)E11.4,17H ANGULAR MOMENTUMI5,17H NO OF RESONANSIG2161
     2CESI5)                                                            SIG2162
   23 FORMAT(85H      ERES           SPIN           GTOT            GN  SIG2163
     1         GGAMMA          GF )                                     SIG2164
   24 FORMAT(11H TITLE     7A4)                                         SIG2165
   25 FORMAT(//)                                                        SIG2166
   26 FORMAT(6(2X,E11.4,2X))                                            SIG2167
   27 FORMAT(33H CROSS-SECTIONS AT THERMAL ENERGY)                      SIG2168
   28 FORMAT(2X,2E20.6,I10)                                             SIG2169
   29 FORMAT(2X,4E11.4)                                                 SIG2170
   30 FORMAT(22H EFFECTIVE TEMPERATUREF7.1,41H  IN DEGREES KELVIN,   NO SIG2171
     1OF PIVOT POINTSI5,18H CONVERGENCE ERRORE10.4,13H AND INCROSS=I5)  SIG2172
   31 FORMAT(53H THE INTEGRAL FOR DOPPLER BROADENING DID NOT CONVERGE)  SIG2173
   33 FORMAT(116H1 PROGRAM SIGMA2, PROGRAM TO CALCULATE SINGLE OR MULTILSIG2174
     1EVEL BREIT-WIGNER CROSS-SECTIONS, USES ENDF/B VERSION II DATA)    SIG2175
C-----THIS IS WHERE RESONANCES OF EACH ISOTOPE ARE ARRANGED IN INCREASINSIG2176
C-----G ORDER IN L AND FOR EACH L IN INCREASING ORDER IN J,             SIG2177
      DO 133 I=1,NIS                                                    SIG2178
      NRESI=NRES(I)                                                     SIG2179
      CALL ORDER(I,NRESI)                                               SIG2180
  133 CONTINUE                                                          SIG2181
```

```
   13 FORMAT(10(1X,I10))                                                SIG2182
      DO 135I=1,NTOTAL                                                  SIG2183
      ARAY(1,I)=ARAY(1,I)*SCALE                                         SIG2184
      ARAY(3,I)=ARAY(3,I)*SCALE                                         SIG2185
      ARAY(4,I)=ARAY(4,I)*SCALE                                         SIG2186
      ARAY(5,I)=ARAY(5,I)*SCALE                                         SIG2187
      ARAY(6,I)=ARAY(6,I)*SCALE                                         SIG2188
  135 CONTINUE                                                          SIG2189
      NCOUNT=1                                                          SIG2190
      DO 1330 I=1,NIS                                                   SIG2191
      XWR=AWRI(I)                                                       SIG2192
      YWR=XWR*1.008665                                                  SIG2193
      YWR=YWR**(1.0/3.0)                                                SIG2194
      APX=0.123*YWR+0.08                                                SIG2195
      NRESI=NRES(I)                                                     SIG2196
      NLMT=NCOUNT*NRESI-1                                               SIG2197
      DO 1331 J=NCOUNT,NLMT                                             SIG2198
      CALL FACTS(ARAY(1,J),IRAY(1,J),PENFAR(J),SHIFAR(J),PS,CONST,XWR,  SIG2199
     1APX,1.0)                                                          SIG2200
 1331 CONTINUE                                                          SIG2201
      NCOUNT=NCOUNT+NRESI                                               SIG2202
 1330 CONTINUE                                                          SIG2203
      DO 108 I=1,NTOTAL                                                 SIG2204
      ERAN(1,I)=ARAY(1,I)                                               SIG2205
      ERAN(2,I)=ARAY(3,I)                                               SIG2206
  108 CONTINUE                                                          SIG2207
      CALL QIKS(1,NTOTAL,MOV,KOM)                                       SIG2208
C---C-HERE RESONANCE IN AN ELEMENT ARE ARRANGED IN INCREASING ORDER IN   SIG2209
C---C-ENERGY ALONG WITH THEIR TOTAL GAMMAS TO CALCULATE THE ENERGY MESH  SIG2210
C-C-C-AT WHICH THE CROSS-SECTIONS ARE CALCULATED.                       SIG2211
  146 PRINT27                                                           SIG2212
      PRINT25                                                           SIG2213
      PRINT7                                                            SIG2214
      E=ETHERM                                                          SIG2215
      CALL SIGMA(ETHERM,1)                                              SIG2216
      PRINT25                                                           SIG2217
      ELO=EL(1,1)*SCALE                                                 SIG2218
      JFLAG(1)=1                                                        SIG2219
      IRANGE=1                                                          SIG2220
C---C-WE HAVE ARBITRARILY SET ELO=1.0E-11 MEV HERE TO BE ABLE TO DOPPLERSIG2221
C---C-BROADEN THERMAL CROSS-SECTIONS,LATER ON IN THE PROGRAM ELO IS READSIG2222
C---C-IN FROM THE DATA AND COULD VARY FROM 1.0E-11 TO 1.0E-09MEV.        SIG2223
      PRINT8,ETHERM,(AREF(LL),LL=1,6)                                   SIG2224
      IF(IDPL.EQ.1)GO TO 147                                            SIG2225
      GO TO 148                                                         SIG22251
  147 TEF=TEFF/293.0                                                    SIG2226
      DELTA=0.3177*SQRT ((TEF*ETHERM)/AWR)                              SIG2227
C     CONTINUE                                                          SIG2228
      CALL GRID(ETHERM,DELTA,NTAB,XTAB)                                 SIG2229
      CALL GREAT2(DOPPLER,FINT,XTAB,NTAB,ERROR,IERR)                    SIG2230
      PRINT28,ETHERM,FINT,JFLAG(1)                                      SIG2231
      IF(IERR.EQ.1)PRINT31                                              SIG2232
  148 PRINT25                                                           SIG2233
      PRINT7                                                            SIG2234
      PRINT25                                                           SIG2235
      DO 124 JJ=1,NIS                                                   SIG2236
      NERJJ=NER(JJ)                                                     SIG2237
      DO 125 KK=1,NERJJ                                                 SIG2238
      IRANGE=KK                                                         SIG2239
      LRUJK=LRU(JJ,KK)                                                  SIG2240
      IF(LRUJK-1)131,1321,125                                           SIG2241
```

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 131 PRINT10                                                                    SIG2242
     GO TO 130                                                                  SIG2243
1321 IF(JJ.EQ.1)GO TO 1320                                                      SIG2244
     GO TO 132                                                                  SIG22441
1320 ELOREF=EL(JJ,KK)*SCALE                                                     SIG2245
     EHIREF=EH(JJ,KK)*SCALE                                                     SIG2246
     ELO=ELOREF                                                                 SIG2247
     EHI=EHIREF                                                                 SIG2248
     GO TO 1240                                                                 SIG2249
 132 ELO=EL(JJ,KK)*SCALE                                                        SIG2250
     EHI=EH(JJ,KK)*SCALE                                                        SIG2251
     IF(ELO.EQ.ELOREF.AND.EHI.EQ.EHIREF)GO TO 124                               SIG2252
     GO TO 1240                                                                 SIG22521
1240 MM=MAXPTS/(8*MAXRES)                                                       SIG2253
     NN=MM                                                                      SIG2254
     IFLAG=1                                                                    SIG2255
     NLSKK=NLS(JJ,KK)                                                           SIG2256
     J4=1                                                                       SIG2257
     ISTART=1                                                                   SIG2258
     IEND=1                                                                     SIG2259
 117 IF(IEND.EQ.0)GO TO 125                                                     SIG2260
     J5=J4+1                                                                    SIG2261
     E1=ERAN(1,J4)                                                              SIG2262
     G1=ERAN(2,J4)                                                              SIG2263
     E2=ERAN(1,J5)                                                              SIG2264
     G2=ERAN(2,J5)                                                              SIG2265
     IF(E1.LT.ELO.AND.E2.LT.ELO)GO TO 1120                                      SIG2266
     GO TO 1105                                                                 SIG22661
1105 IF(E1.LE.ELO.AND.E2.GT.ELO)GO TO 1110                                      SIG2267
     GO TO 1111                                                                 SIG22671
1110 E1=ELO                                                                     SIG2268
     G1=G2                                                                      SIG2269
     ISTART=0                                                                   SIG2270
     GO TO 1114                                                                 SIG2271
1111 IF(E1.GT.ELO.AND.E2.LE.EHI)GO TO 1112                                      SIG2272
     GO TO 1113                                                                 SIG22721
1112 IF(J4.EQ.1.AND.ISTART.EQ.1)GO TO 1106                                      SIG2273
     GO TO 1114                                                                 SIG22731
1106 E2=E1                                                                      SIG2274
     G2=G1                                                                      SIG2275
     E1=ELO                                                                     SIG2276
     J4=J4-1                                                                    SIG2277
     ISTART=0                                                                   SIG2278
     GO TO 1114                                                                 SIG2279
1116 E2=EHI+G1/FLOAT (MM)                                                       SIG2280
     G2=G1                                                                      SIG2281
     IFLAG=0                                                                    SIG2282
     GO TO 1114                                                                 SIG2283
1113 IF(E1.LT.EHI.AND.E2.GE.EHI)GO TO 1123                                      SIG2284
     GO TO 1124                                                                 SIG22841
1123 E2=EHI                                                                     SIG2285
     G2=G1                                                                      SIG2286
     IEND=0                                                                     SIG2287
     GO TO 1114                                                                 SIG2288
1124 IF(E1.GE.EHI.AND.E2.GT.EHI)GO TO 125                                       SIG2289
     GO TO 1125                                                                 SIG22891
1125 IF(IFLAG)1120,125,1120                                                     SIG2290
1114 IF(E1.EQ.E2)GO TO 1120                                                     SIG2291
     GO TO 1118                                                                 SIG22911
1118 CONTINUE                                                                   SIG2292
     CALL SIEVE(E1,G1,E2,G2,MM,NN,NX,TEFF,AWR)                                  SIG2293
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      CALL QIKS(1,NX,MOVE,KOME)                                          SIG2294
      GO TO 116                                                          SIG2295
 1120 IF(IEND.EQ.0)GO TO 125                                             SIG2296
      J4=J4+1                                                            SIG2297
      GO TO 117                                                          SIG2298
  116 DO 109 I=1,NX                                                      SIG2299
      E=EX(I)                                                            SIG2300
      JFLAGI=JFLAG(I)                                                    SIG2301
      CALL SIGMA(E,KK)                                                   SIG2302
      PRINT8,E,(AREF(LL),LL=1,6)                                         SIG2303
      IF(IDPL.EQ.1)GO TO 141                                             SIG2304
      GO TO 109                                                          SIG23041
  141 IF(E.LT.ETHERM)GO TO 109                                           SIG2305
      GO TO 1410                                                         SIG23051
C-----IF THE NEUTRON ENERGY IS LESS THAN 0,0253 EV DOPPLER BROADENING IS SIG2306
C-----PASSED AS A DIFFERENT KERNEL SHOULD BE USED TO CALCULATE DOPPLER   SIG2307
C-----BROADENED CROSS-SECTIONS.                                          SIG2308
 1410 TEF=TEFF/293.0                                                     SIG2309
      DELTA=0.3177*SQRT ((TEF*E)/AWR)                                    SIG2310
C     CONTINUE                                                           SIG2311
      GO TO (1121,1122),JFLAGI                                           SIG2312
 1121 CALL GRID(E,DELTA,NTAB,XTAB)                                       SIG2313
   32 FORMAT(2X,11E11.4)                                                 SIG2314
      CALL GREAT2(DOPPLER,FINT,XTAB,NTAB,ERROR,IERR)                     SIG2315
      PRINT28,E,FINT,JFLAG(I)                                            SIG2316
      IF(IERR.EQ.1)PRINT31                                               SIG2317
      GO TO 109                                                          SIG2318
 1122 CALL GAUSS(E,DELTA,DOPE)                                           SIG2319
      PRINT28,E,DOPE,JFLAG(I)                                            SIG2320
  109 CONTINUE                                                           SIG2321
      IF(IFLAG)1117,125,1117                                             SIG2322
 1117 J4=J4+1                                                            SIG2323
      IF(NTOTAL-J4)125,1250,117                                          SIG2324
 1250 E1=ERAN(1,J4)                                                      SIG2325
      G1=ERAN(2,J4)                                                      SIG2326
      GO TO 1116                                                         SIG2327
  125 CONTINUE                                                           SIG2328
  124 CONTINUE                                                           SIG2329
  120 CONTINUE                                                           SIG2330
  130 CALL EXIT                                                          SIG2331
      END                                                                SIG2332
      SUBROUTINE QIKS (MM,NN,MOVE,COMPAR)                                QIKS0010
CQIKS          ALL-IN-MEMORY SORT PROGRAM                               QIKS0020
C     MM = FIRST SUBSCRIPT                                               QIKS0030
C     NN = LAST SUBSCRIPT  (ARRAY IS IN COMMON)                          QIKS0040
C     MOVE AND COMPAR ARE USER SUPPLIED PROGRAMS                         QIKS0050
      DIMENSION MSAVE(20),NSAVE(20)                                      QIKS0060
      KEYLOC(M,N)=(N+M)/2                                                QIKS0070
      I=0                                                                QIKS0080
      J=0                                                                QIKS0090
      LEVEL  = 0                                                         QIKS0100
      M=MM                                                               QIKS0110
      N=NN                                                               QIKS0120
   35 CONTINUE                                                           QIKS0130
C     TEST FOR ONE OR TWO ITEMS                                          QIKS0140
      IF(N-M-1) 31,51,32                                                 QIKS0150
C  32 CONTINUE                                                           QIKS0160
C     PARTITION AND SPREADER GO HERE, SEE BELOW,  RETURN IS TO 8         QIKS0170
C     PUSH DOWN                                                          QIKS0180
    8 LEVEL=LEVEL+1                                                      QIKS0190
C     WORK ON SMALLEST PORTION                                           QIKS0200
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      NSAVE(LEVEL)=N                                                    QIKS0230
      N=J                                                               QIKS0240
      GO TO 35                                                          QIKS0250
   34 MSAVE(LEVEL)=M                                                    QIKS0260
      NSAVE(LEVEL)=J                                                    QIKS0270
      M=I                                                               QIKS0280
      GO TO 35                                                          QIKS0290
   51 IF(COMPAR(M,N))31,31,131                                          QIKS0300
C     SWAP IF ONLY TWO ITEMS ARE OUT OF ORDER                           QIKS0310
  131 CALL MOVE(M,0)                                                    QIKS0320
      CALL MOVE(N,M)                                                    QIKS0330
      CALL MOVE(0,N)                                                    QIKS0340
   31 IF (LEVEL) 151, 150, 151                                          QIKS0350
  150 RETURN                                                            QIKS0360
C     POP UP                                                            QIKS0370
  151 M = MSAVE(LEVEL)                                                  QIKS0380
      N=NSAVE(LEVEL)                                                    QIKS0390
      LEVEL=LEVEL-1                                                     QIKS0400
      GO TO 35                                                          QIKS0410
C     END   MAIN                                                        QIKS0420
C     PARTITION                                                         QIKS0430
   32 I=M                                                               QIKS0440
      J=N                                                               QIKS0450
      KEY=KEYLOC(M,N)                                                   QIKS0460
      CALL MOVE(KEY, 0)                                                 QIKS0470
   54 IF (N - KEY) 17, 1, 17                                            QIKS0480
   17 CALL MOVE(N,KEY)                                                  QIKS0490
    1 CONTINUE                                                          QIKS0500
C     HOLE AT BOTTOM                                                    QIKS0510
      IF(COMPAR(0,I))3,2,2                                              QIKS0520
    2 I=I+1                                                             QIKS0530
      IF (I - J) 1, 4, 1                                                QIKS0540
    3 CALL MOVE(I,J)                                                    QIKS0550
      GO TO 5                                                           QIKS0560
    6 CONTINUE                                                          QIKS0570
C     HOLE AT TOP                                                       QIKS0580
      IF(COMPAR(0,J))5,5,7                                              QIKS0590
    5 J=J-1                                                             QIKS0600
      IF (I - J) 6, 4, 6                                                QIKS0610
    7 CALL MOVE(J,I)                                                    QIKS0620
      GO TO 2                                                           QIKS0630
C   4 CONTINUE                                                          QIKS0640
C     SPREADER GOES HERE                                                QIKS0650
C     END   PARTITION                                                   QIKS0660
C     SPREADER                                                          QIKS0670
    4 CALL MOVE(0,I)                                                    QIKS0680
   12 IF (I - N) 110, 10, 110                                           QIKS0690
  110 I = I + 1                                                         QIKS0700
      IF(COMPAR(0,I))10,12,10                                           QIKS0710
   10 IF (J - M) 108, 8, 108                                            QIKS0720
  108 J = J - 1                                                         QIKS0730
      IF(COMPAR(0,J))8,10,8                                             QIKS0740
C   8 CONTINUE                                                          QIKS0750
C     RETURN TO MAIN PROGRAM                                            QIKS0760
      END                                                               QIKS0770
      SUBROUTINE MOV(I,J)                                               MOV 001
      COMMON/D/ERAN(2,501)                                              MOV 002
      I1=I                                                              MOV 003
      J1=J                                                              MOV 004
```

```
      IF(I1.EQ.0)I1=501                                                 MOV 005
      IF(J1.EQ.0)J1=501                                                 MOV 006
      ERAN(1,J1)=ERAN(1,I1)                                             MOV 007
      ERAN(2,J1)=ERAN(2,I1)                                             MOV 008
      RETURN                                                            MOV 009
      END                                                               MOV 010
      SUBROUTINE MOVE(I,J)                                              MOVE001
      COMMON/C/EX(101),JFLAG(101)                                       MOVE002
      I1=I                                                              MOVE003
      J1=J                                                              MOVE004
      IF(I1.EQ.0)I1=101                                                 MOVE005
      IF(J1.EQ.0)J1=101                                                 MOVE006
      EX(J1)=EX(I1)                                                     MOVE007
      JFLAG(J1)=JFLAG(I1)                                               MOVE008
      RETURN                                                            MOVE009
      END                                                               MOVE010
      FUNCTION KOM(I,J)                                                 KOM 001
      COMMON/D/ERAN(2,501)                                              KOM 002
      I1=I                                                              KOM 003
      J1=J                                                              KOM 004
      IF(I1.EQ.0)I1=501                                                 KOM 005
      IF(J1.EQ.0)J1=501                                                 KOM 006
      EOM=ERAN(1,I1)-ERAN(1,J1)                                         KOM 007
      IF(EOM)100,101,102                                                KOM 008
  100 KOM=-1                                                            KOM 009
      GO TO 103                                                         KOM 010
  101 KOM=0                                                             KOM 011
      GO TO 103                                                         KOM 012
  102 KOM=1                                                             KOM 013
  103 RETURN                                                            KOM 014
      END                                                               KOM 015
      FUNCTION KOME(I,J)                                                KOME001
      COMMON/C/EX(101),JFLAG(101)                                       KOME002
      I1=I                                                              KOME003
      J1=J                                                              KOME004
      IF(I1.EQ.0)I1=101                                                 KOME005
      IF(J1.EQ.0)J1=101                                                 KOME006
      EOX=EX(I1)-EX(J1)                                                 KOME007
      IF(EOX)100,101,102                                                KOME008
  100 KOME=-1                                                           KOME009
      GO TO 103                                                         KOME010
  101 KOME=0                                                            KOME011
      GO TO 103                                                         KOME012
  102 KOME=1                                                            KOME013
  103 RETURN                                                            KOME014
      END                                                               KOME015
      SUBROUTINE SPINOR(S,L,XJ)                                         SPNR001
      TERM=0.0                                                          SPNR002
      DENOM=2.0                                                         SPNR003
      IF(S.EQ.0.,.AND.L.EQ.0)GO TO 100                                  SPNR004
      GO TO 101                                                         SPNR0041
C-----FOR S=0 AND S-WAVE RESONANCES SPINS ARE ALL KNOWN HENCE ONE NEEDS SPNR005
C-----LEVEL-LEVEL INTERFERENCE.                                         SPNR006
  101 IF(S.EQ.0.)GO TO 102                                              SPNR007
      GO TO 103                                                         SPNR0071
  102 XJ=FLOAT (L)                                                      SPNR008
      GO TO 110                                                         SPNR009
  103 XJ1=S+0.5                                                         SPNR010
      XJ2=S-0.5                                                         SPNR011
  111 XL=FLOAT (L)                                                      SPNR012
      IF(XJ1.GT.XL)GO TO 104                                            SPNR013
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      GO TO 105                                                          SPNR0131
  104 TERM=TERM+XJ1*(2.0*XL+1.0)                                         SPNR014
      DENOM=DENOM+(2.0*XL+1.0)                                           SPNR015
      GO TO 106                                                          SPNR016
  105 TERM=TERM+XL*(2.0*XJ1+1.0)                                         SPNR017
      DENOM=DENOM+(2.0*XJ1+1.0)                                          SPNR018
  106 IF(XJ2.GT.XL)GO TO 107                                             SPNR019
      GO TO 108                                                          SPNR0191
  107 TERM=TERM+XJ2*(2.0*XL+1.0)                                         SPNR020
      DENOM=DENOM+(2.0*XL+1.0)                                           SPNR021
      GO TO 109                                                          SPNR022
  108 TERM=TERM+XL*(2.0*XJ2+1.0)                                         SPNR023
      DENOM=DENOM+(2.0*XJ2+1.0)                                          SPNR024
  109 XJ=TERM/DENOM                                                      SPNR025
      GO TO 110                                                          SPNR026
  100 XJ=0.0                                                             SPNR027
  110 RETURN                                                             SPNR028
      END                                                                SPNR029
      SUBROUTINE GREAT2(F,FINT,XTAB,NTAB,ERROR,IERR)                     GRT2001
C---=-CARRY OUT CONVERGENCE INTEGRATION SCHEME USING UP TO 200 INTERVALSGRT2002
C---=-WHICH ARE THEN FURTHER SUBDIVIDED UNTIL CONVERGENCE OCCURS OR THE GRT2003
C----=-MAXIMUM ALLOWABLE NUMBER OF ITERATIONS IS EXCEEDED, THE SUBROUTINEGRT2004
C---=-ARGUMENTS ARE DEFINED AS FOLLOWS.....,                             GRT2005
C----=-F      =FUNCTION TO BE INTEGRATED,                                GRT2006
C---=-FINT  =THE RESULTING INTEGRAL                                      GRT2007
C---=-XTAB  =TABLE OF ORDINATES (INTEGRATION INTERVAL IS FROM XTAB(1) TOGRT2008
C----=       XTAB(NTAB))                                                 GRT2009
C---=-NTAB  =THE LENGTH OF THE XTAB TABLE (NUMBER OF ORDINATES),         GRT2010
C---=-ERROR =ALLOWABLE NORMAL ERROR,                                     GRT2011
C----=-IERR  =ERROR INDICATOR SET TO ZERO IF METHOD CONVERGES, SET TO    GRT2012
C----=       ONE IF METHOD DOES NOT CONVERGE,                            GRT2013
C----=       ONE IF METHOD DOES NOT CONVERGE OR TABLE (XTAB) IS TOO LONGGRT2014
      DIMENSION XTAB(33),PARTS(33),GOOF(33),INTER(33)                    GRT2015
C---=-DEFINE THE MAXIMUM ALLOWABLE NUMBER OF ITERATIONS AND THE MAXIMUM GRT2016
C---=-TABLE LENGTH,                                                      GRT2017
      DATA JMAX,NTABMX/20,1000/                                          GRT2018
C---=-DETERMINE IF TABLE IS TOO LONG                                     GRT2019
      IF(NTAB.GT.NTABMX) GO TO 100                                       GRT2020
C----=CALL GENERAL INTEGRATION SUBROUTINE,                               GRT2021
      ZZZ=F(5.0)                                                         GRT20211
      CALL GREAT1(F,FINT,NTAB,JMAX,XTAB,PARTS,GOOF,INTER,ERROR,IERR)     GRT2022
      RETURN                                                             GRT2023
C---=-TABLE IS TOO LONG,                                                 GRT2024
  100 IERR=1                                                             GRT2025
      FINT=0.0                                                           GRT2026
      RETURN                                                             GRT2027
      END                                                                GRT2028
      SUBROUTINE GREAT1(F,FINT,NTAB,JMAX,XTAB,PARTS,GOOF,INTER,ERROR,    GRT1001
     1 IERR)                                                             GRT1002
C---=-CARRY OUT CONVERGENCE INTEGRATION SCHEME USING TRAPAZOIDAL RULE    GRT1003
C---=-AND DOUBLING THE NUMBER OF REGIONS PER SUBINTERVAL FOR EACH        GRT1004
C---=-ITERATION, ONLY DOUBLE UP IN THOSE INTERVALS THAT HAVE NOT ALREADYGRT1005
C---=-CONVERGED,                                                         GRT1006
C---=-F      =SINGLE PRECISION FUNCTION TO BE INTEGRATED                 GRT1007
C---=-FINT  =THE RESULTING INTEGRAL                                      GRT1008
C---=-NTAB  =NUMBER OF ORDINATES SUPPLIED (THERE ARE N-1 INTERVALS)      GRT1009
C----=JMAX  =MAXIMUM ALLOWABLE NUMBER OF ITERATIONS                      GRT1010
C---=-XTAB  =TABLE OF THE ORDINATE VALUES, RANGE OF INTEGRATION IS       GRT1011
C----=       FROM XTAB(1) TO XTAB(NTAB)                                  GRT1012
C---=-PARTS =ARRAY OF DIMENSION NTAB, EQUAL TO THE PARTIAL INTEGRALS     GRT1013
C----=       OVER EACH OF THE NTAB-1 INTERVALS                           GRT1014
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C---==GOOF  =ARRAY OF DIMENSION NTAB, EQUAL TO THE NORMAL ERROR IN EACH GRT1015
C-----=      OF THE NTAB-1 INTERVAL.                                   GRT1016
C---==INTER =ARRAY OF DIMENSION NTAB, SEPECIFYING THE NUMBER OF        GRT1017
C----=       SUBINTERVALS IN EACH INTERVAL                             GRT1018
C-----ERROR =ACCEPTABLE NORMAL ERROR                                   GRT1019
C---==IERR  =ERROR INDICATOR, SET TO ZERO IF METHOD CONVERGES, SET TO  GRT1020
C----=       ONE IF METHOD DOES NOT CONVERGE                           GRT1021
      DIMENSION XTAB(NTAB),PARTS(NTAB),INTER(NTAB),GOOF(NTAB)          GRT1022
C----==INITIALIZE VALUE OF THE INTEGRAL                                GRT1023
      FINT=0.0                                                         GRT1024
C----=CALCULATE THE NUMBER OF INTERVALS                                GRT1025
      NM1=NTAB-1                                                       GRT1026
C----=CALCULATE ALLOWABLE ERROR PER INTERVAL                           GRT1027
      ERRN=ERROR/FLOAT(NM1)                                            GRT1028
C---==INITIALIZE APPROXIMATION TO INTEGRAL                             GRT1029
      TOTAL=0.0                                                        GRT1030
C---==CALCULATE INITIAL APPROXIMATION                                  GRT1031
      DO 10 I=1,NM1                                                    GRT1032
      INTER(I)=1                                                       GRT1033
      PARTS(I)=0.5*(XTAB(I+1)-XTAB(I))*(F(XTAB(I+1))+F(XTAB(I)))       GRT1034
   10 TOTAL=TOTAL+PARTS(I)                                             GRT1035
C---=CALCULATE INITIAL ERRORS                                          GRT1036
      DO 15 I=1,NM1                                                    GRT1037
   15 GOOF(I)=PARTS(I)                                                 GRT1038
C---==SET UP LOOP OVER ITERATIONS                                      GRT1039
      DO 100 J=1,JMAX                                                  GRT1040
C-----SAVE LAST APPROXIMATION                                          GRT1041
      TOTAL1=TOTAL                                                     GRT1042
C---=SET UP LOOP OVER INTERVALS                                        GRT1043
      DO 20 I=1,NM1                                                    GRT1044
C---=CHECK FOR CONVERGENCE IN THIS INTERVAL                            GRT1045
      IF(ABS(GOOF(I)/TOTAL).LT.ERRN) GO TO 20                          GRT1046
C---=CALCULATE DOUBLE INTERVAL                                         GRT1047
      DX=(XTAB(I+1)-XTAB(I))/FLOAT(INTER(I))                           GRT1048
C---=DOUBLE NUMBER OF STEPS                                            GRT1049
      INTER(I)=2*INTER(I)                                              GRT1050
C---=INITIALIZE CONTRIBUTION TO INTEGRAL                               GRT1051
      REST=0.0                                                         GRT1052
      II=INTER(I)                                                      GRT1053
C----INITIALIZE ORDINATE                                               GRT1054
      XNOW=XTAB(I)+0.5*DX                                              GRT1055
C---==SET UP LOOP OVER ORDINATES                                       GRT1056
      DO 30 K=1,II,2                                                   GRT1057
      REST=REST+F(XNOW)                                                GRT1058
   30 XNOW=XNOW+DX                                                     GRT1059
C---==CALCULATE NEXT PARTIAL INTEGRAL                                  GRT1060
      REST=0.5*(PARTS(I)+DX*REST)                                      GRT1061
C---==ADD NEW PARTIAL INTEGRAL AND SUBTRACT OLD PARTIAL INTEGRAL       GRT1062
      TOTAL=TOTAL+REST-PARTS(I)                                        GRT1063
C-----CALCULATE NEW ERROR AND SET PARTIAL INTEGRAL TO NEW VALUE        GRT1064
      GOOF(I)=REST-PARTS(I)                                            GRT1065
      PARTS(I)=REST                                                    GRT1066
   20 CONTINUE                                                         GRT1067
C---=CHECK FOR CONVERGENCE                                             GRT1068
  100 IF(ABS(1.-TOTAL1/TOTAL).LE.ERROR) GO TO 200                      GRT1069
C---==THE METHOD HAS NOT CONVERGED                                     GRT1070
      FINT=TOTAL                                                       GRT1071
      IERR=1                                                           GRT1072
      RETURN                                                           GRT1073
C---=THE METHOD HAS CONVERGED                                          GRT1074
  200 FINT=TOTAL                                                       GRT1075
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      IERR=0                                                                GRT1076
      RETURN                                                                GRT1077
      END                                                                   GRT1078
      SUBROUTINE GRID(Q,BELTA,NTAB,XTAB)                                    GRID001
      COMMON ARAY,IRAY,ERAY,NOT,ZAI,ABN,NER,LFW,EL,EH,LRU,LRF,LANG,NLS,     GRID002
     1NRES,LN,JN,PENFAR,SHIFAR,SPI,AP,AWRI,AM,DREF,AREF,BREF,IRANGE,NIS,    GRID003
     3INCROSS,IVSPIN,ELO,TEFF,DELTA,E,AWR                                   GRID004
      DIMENSION ARAY(6,500),IRAY(3,500),ERAY(2,500),NOT(20),ZAI(10),        GRID005
     1ABN(10),NER(10),LFW(10),EL(10,10),EH(10,10),LRU(10,10),LRF(10,10),    GRID006
     2LANG(10,5,5),NLS(10,10),NRES(10),LN(50),JN(150),PENFAR(500),          GRID007
     3SHIFAR(500),SPI(10),AP(10),AWRI(10),AM(10),DREF(6),AREF(6),BREF(6,    GRID008
     410)                                                                   GRID009
      DIMENSION XTAB(33)                                                    GRID010
      IGNORE=1                                                              GRID011
      N2=NTAB/2                                                             GRID012
      N21=N2+1                                                              GRID013
      N22=N2+2                                                              GRID014
      N3=NTAB-1                                                             GRID015
      XTAB(N21)=Q                                                           GRID016
      DO 1410 I=N22,NTAB                                                    GRID017
      XTAB(I)=XTAB(I-1)+BELTA                                               GRID018
      II=NTAB+1-I                                                           GRID019
      XTAB(II)=XTAB(II+1)-BELTA                                             GRID020
1410  CONTINUE                                                              GRID021
      DO 1411 I=1,NTAB                                                      GRID022
      XTABI=XTAB(I)                                                         GRID023
      IF(XTABI)1412,1412,1411                                               GRID024
1412  IGNORE=0                                                              GRID025
1411  CONTINUE                                                              GRID026
      IF(IGNORE.EQ.0)GO TO 1413                                             GRID027
      GO TO 1414                                                            GRID0271
1413  XTAB(1)=1.0E-03                                                       GRID028
      DO 1415 I=1,N3                                                        GRID029
      I1=I+1                                                                GRID030
      XTAB(I1)=XTAB(1)+FLOAT (I)*BELTA                                      GRID031
1415  CONTINUE                                                              GRID032
1414  RETURN                                                                GRID033
      END                                                                   GRID034
      SUBROUTINE GAUSS(Q,BELTA,DOPE)                                        GAUS001
      COMMON ARAY,IRAY,ERAY,NOT,ZAI,ABN,NER,LFW,EL,EH,LRU,LRF,LANG,NLS,     GAUS002
     1NRES,LN,JN,PENFAR,SHIFAR,SPI,AP,AWRI,AM,DREF,AREF,BREF,IRANGE,NIS,    GAUS003
     3INCROSS,IVSPIN,ELO,TEFF,DELTA,E,AWR                                   GAUS004
      DIMENSION ARAY(6,500),IRAY(3,500),ERAY(2,500),NOT(20),ZAI(10),        GAUS005
     1ABN(10),NER(10),LFW(10),EL(10,10),EH(10,10),LRU(10,10),LRF(10,10),    GAUS006
     2LANG(10,5,5),NLS(10,10),NRES(10),LN(50),JN(150),PENFAR(500),          GAUS007
     3SHIFAR(500),SPI(10),AP(10),AWRI(10),AM(10),DREF(6),AREF(6),BREF(6,    GAUS008
     410)                                                                   GAUS009
      DIMENSION ABC(9),WET(9)                                               GAUS010
      DATA ABC/-3.1909932017815 3,-2.2665805845 3184,-1.4685532892 1667,-0, GAUS011
     172355101875284,0.0.0.723551018752 84,1.4685532892 1667,2.2665805845 3GAUS012
     2184,3.1909932017815 3/                                                GAUS013
      DATA WET/0.3960697726326E-04,0.4943624275537E-02,0.8847452739438E-GAUS014
     101,0.4326515570026E+00,0.7202352156061E+00,0.4326515570026E+00,0.8GAUS015
     2847452739438E-01,0.4943624275537E-02,0.3960697726326E-04/             GAUS016
      DATA PHIRT/1.772454/                                                  GAUS017
      TEF=TEFF/293.0                                                        GAUS018
      TERM=0.0                                                              GAUS019
      DO 200 K=1,NIS                                                        GAUS020
      T1=0.0                                                                GAUS021
      XWR=AWRI(K)                                                           GAUS022
      BELTA=(0.3177E+00)*SQRT((Q*TEF)/XWR)                                  GAUS023
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      X=BELTA*ABC(9)                                                    GAUS024
      IF(E-X)100,100,101                                                GAUS025
  101 DO 102 I=1,9                                                      GAUS026
      ABCI=ABC(I)                                                       GAUS027
      WETI=WET(I)                                                       GAUS028
      Z=E+ABCI*BELTA                                                    GAUS029
      CALL SIGMA(Z,IRANGE)                                              GAUS030
      T1=T1+BREF(INCROSS,K)*WETI                                        GAUS031
  102 CONTINUE                                                          GAUS032
      GO TO 110                                                         GAUS033
  100 T1=0.0                                                            GAUS034
  110 TERM=TERM+T1                                                      GAUS035
  200 CONTINUE                                                          GAUS036
      DOPE=TERM/PHIRT                                                   GAUS037
      RETURN                                                            GAUS038
      END                                                               GAUS039
      SUBROUTINE FACTS(Q,L,PF,SF,PS,CONSTE,BWR,BP,PLOD)                 FACT001
C                                                                       FACT002
C     SUBROUTINE TO CALCULATE PENETRATION AND                           FACT003
C              SHIFT FACTORS                                            FACT004
C     Q IS THE ENERGY L IS THE ANGULAR MOMENTUM PF PENETRATION FACTOR   FACT005
C     SF THE SHIFT FACTOR AND PS THE PHASE SHIFT AP IS R CONSTE IS KM   FACT006
C     FOR DETAILS OF FORMULAE SEE GREGSON ET AL AEEW-M517(MLBW)1965     FACT007
C                                                                       FACT008
      DATA WNEUT/1.008665/                                              FACT009
      EAB=ABS(Q)                                                        FACT010
      CONHLD=2.196771E-03*BWR*SQRT(EAB)                                 FACT011
      CONSTE=CONHLD/(BWR+1.0)                                           FACT012
C-----SINCE AWR IS GIVEN WITH THE NEUTRON MASS AS UNITY WE ADD ONE ABOVE FACT013
C-----TO CONVERT TO THE CENTER-OF-MASS SYSTEM                           FACT014
      ROE=BP*CONSTE                                                     FACT015
      S=FLOAT (L)                                                       FACT016
      IF(L.LE.0)GO TO 100                                               FACT017
      GO TO(110,120,130,140,150),L                                      FACT018
  100 PF=ROE                                                            FACT019
      SF=0.0                                                            FACT020
      IF(PLOD.LT.2.0) GO TO 160                                         FACT021
      PS=ROE                                                            FACT022
      GO TO 170                                                         FACT023
  110 ROE2=ROE*ROE                                                      FACT024
      DENOM=1.0+ROE2                                                    FACT025
      PF=ROE2*ROE/DENOM                                                 FACT026
      SF=-1.0/DENOM                                                     FACT027
      IF(PLOD.LT.2.0) GO TO 160                                         FACT028
      PS=ROE-ATAN (ROE)                                                 FACT029
      IF(PS/ROE-0.000001)160,170,170                                    FACT030
  120 ROE2=ROE*ROE                                                      FACT031
      ROE4=ROE2*ROE2                                                    FACT032
      DENOM=3.0*ROE2+ROE4+9.0                                           FACT033
      PF=ROE4*ROE/DENOM                                                 FACT034
      SF=-(18.0+3.0*ROE2)/DENOM                                         FACT035
      IF(PLOD.LT.2.0) GO TO 160                                         FACT036
      PS=ROE-ATAN (3.0*ROE/(3.0-ROE2))                                  FACT037
      IF(PS/ROE-0.000001)160,170,170                                    FACT038
  130 ROE2=ROE*ROE                                                      FACT039
      ROE4=ROE2*ROE2                                                    FACT040
      ROE6=ROE4*ROE2                                                    FACT041
      DENOM=225.0+45.0*ROE2+6.0*ROE4+ROE6                               FACT042
      PF=ROE6*ROE/DENOM                                                 FACT043
      SF=-(675.0+90.0*ROE2+6.0*ROE4)/DENOM                              FACT044
      IF(PLOD.LT.2.0) GO TO 160                                         FACT045
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      PS=ROE-ATAN ((15,0*ROE-ROE2*ROE)/(15,0-6,0*ROE2))                 FACT046
      IF(PS/ROE-0,000001)160,170,170                                    FACT047
  140 ROE2=ROE*ROE                                                      FACT048
      ROE4=ROE2*ROE2                                                    FACT049
      ROE6=ROE4*ROE2                                                    FACT050
      ROE8=ROE4*ROE4                                                    FACT051
      DENOM=11025,0+1575,0*ROE2+135,0*ROE4+10,0*ROE6+ROE8               FACT052
      PF=ROE8*ROE/DENOM                                                 FACT053
      IF(PLOD LT,2,0) GO TO 160                                         FACT054
      SF=-(44100,0+4725,0*ROE2+270,0*ROE4+10,0*ROE6)/DENOM              FACT055
      PS=ROE-ATAN ((105,0*ROE-10,0*ROE2*ROE)/(105,0-45,0                FACT056
     1*ROE2+ROE4))                                                      FACT057
      IF(PS/ROE-0,000001)160,170,170                                    FACT058
  150 ROE2=ROE*ROE                                                      FACT059
      ROE4=ROE2*ROE2                                                    FACT060
      ROE6=ROE4*ROE2                                                    FACT061
      ROE8=ROE4*ROE4                                                    FACT062
      ROE10=ROE6*ROE4                                                   FACT063
      DENOM=893025,0+99225,0*ROE2+6300,0*ROE4+315,0*ROE6                FACT064
     1+15,0*ROE8+ROE10                                                  FACT065
      PF=ROE10*ROE/DENOM                                                FACT066
      SF=4465125,0+396900,0*ROE2+18900,0*ROE4                           FACT067
     1+630,0*ROE6+15,0*ROE8                                             FACT068
      SF=-SF/DENOM                                                      FACT069
      IF(PLOD-LT,2,0) GO TO 160                                         FACT070
      PS=ROE-ATAN ((945,0*ROE-ROE*(105,0*ROE2-ROE4))/(945,0-420,0*ROE2+ FACT071
     115,0*ROE4))                                                       FACT072
      IF(PS/ROE,GE,0.000001) GO TO 170                                  FACT073
  160 PS=0,0                                                            FACT074
  170 RETURN                                                            FACT075
      END                                                               FACT076
      SUBROUTINE ORDER(K,N1)                                            ORDR001
      COMMON ARAY,IRAY,ERAY,NOT,ZAI,ABN,NER,LFW,EL,EH,LRU,LRF,LANG,NLS, ORDR002
     1NRES,LN,JN,PENFAR,SHIFAR,SPI,AP,AWRI,AM,DREF,AREF,BREF,IRANGE,NIS,ORDR003
     3INCROSS,IVSPIN,ELO,TEFF,DELTA,E,AWR                               ORDR004
      DIMENSION ARAY(6,500),IRAY(3,500),ERAY(2,500),NOT(20),ZAI(10),    ORDR005
     1ABN(10),NER(10),LFW(10),EL(10,10),EH(10,10),LRU(10,10),LRF(10,10),ORDR006
     2LANG(10,5,5),NLS(10,10),NRES(10),LN(50),JN(150),PENFAR(500),      ORDR007
     3SHIFAR(500),SPI(10),AP(10),AWRI(10),AM(10),DREF(6),AREF(6),BREF(6,ORDR008
     410)                                                               ORDR009
      IF(K-1)2,2,3                                                      ORDR010
    2 NTR=0                                                             ORDR011
      NUML=0                                                            ORDR012
      NUMJ=0                                                            ORDR013
      NN=0                                                              ORDR014
      MM=0                                                              ORDR015
      JJ=0                                                              ORDR016
      NC=0                                                              ORDR017
      MC=0                                                              ORDR018
    3 NT=NTR+1                                                          ORDR019
      NTR=NTR+N1                                                        ORDR020
      OL=-0,9                                                           ORDR021
    8 OL=OL+1,0                                                         ORDR022
      DO 101 N=NT,NTR                                                   ORDR023
      TERM=FLOAT (IRAY(1,N))                                            ORDR024
      IF(OL-TERM)101,101,9                                              ORDR025
    9 NN=NN+1                                                           ORDR026
      DO 100J=1,6                                                       ORDR027
      A=ARAY(J,N)                                                       ORDR028
      ARAY(J,N)=ARAY(J,NN)                                              ORDR029
      ARAY(J,NN)=A                                                      ORDR030
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```
  100 CONTINUE                                                          ORDR031
      DO 1001 J=1,3                                                     ORDR032
      IA=IRAY(J,N)                                                      ORDR033
      IRAY(J,N)=IRAY(J,NN)                                              ORDR034
      IRAY(J,NN)=IA                                                     ORDR035
 1001 CONTINUE                                                          ORDR036
      DO 1002 J=1,2                                                     ORDR037
      EA=ERAY(J,N)                                                      ORDR038
      ERAY(J,N)=ERAY(J,NN)                                              ORDR039
      ERAY(J,NN)=EA                                                     ORDR040
 1002 CONTINUE                                                          ORDR041
  101 CONTINUE                                                          ORDR042
      IF(NN-NC)8,8,11                                                   ORDR043
   11 NUML=NUML+1                                                       ORDR044
      LN(NUML)=NN-NC                                                    ORDR045
      NC=NN                                                             ORDR046
      NU=NT+LN(NUML)-1                                                  ORDR047
      OM= 0.25                                                          ORDR048
   14 OM=OM+0.5                                                         ORDR049
      DO 205 M=NT,NU                                                    ORDR050
      TERMJ=ARAY(2,M)                                                   ORDR051
      IF(OM-TERMJ)205,205,15                                            ORDR052
   15 MM=MM+1                                                           ORDR053
      DO 204 J=1,6                                                      ORDR054
      A=ARAY(J,M)                                                       ORDR055
      ARAY(J,M)=ARAY(J,MM)                                              ORDR056
      ARAY(J,MM)=A                                                      ORDR057
  204 CONTINUE                                                          ORDR058
      DO 2041 J=1,3                                                     ORDR059
      IA=IRAY(J,M)                                                      ORDR060
      IRAY(J,M)=IRAY(J,MM)                                              ORDR061
      IRAY(J,MM)=IA                                                     ORDR062
 2041 CONTINUE                                                          ORDR063
      DO 2042 J=1,2                                                     ORDR064
      EA=ERAY(J,M)                                                      ORDR065
      ERAY(J,M)=ERAY(J,MM)                                              ORDR066
      ERAY(J,MM)=EA                                                     ORDR067
 2042 CONTINUE                                                          ORDR068
  205 CONTINUE                                                          ORDR069
      IF(MM-MC)14,14,16                                                 ORDR070
   16 NUMJ=NUMJ+1                                                       ORDR071
      JN(NUMJ)=MM-MC                                                    ORDR072
      MC=MM                                                             ORDR073
      NT=NT+JN(NUMJ)                                                    ORDR074
      IF(NN-MM)17,17,14                                                 ORDR075
   17 IF(NTR-NN)18,18,8                                                 ORDR076
   18 RETURN                                                            ORDR077
      END                                                               ORDR078
      FUNCTION DOPPLER(X)                                               DOPL001
      COMMON ARAY,IRAY,ERAY,NOT,ZAI,ABN,NER,LFW,EL,EH,LRU,LRF,LANG,NLS, DOPL002
     1NRES,LN,JN,PENFAR,SHIFAR,SPI,AP,AWRI,AM,DREF,AREF,BREF,IRANGE,NIS,DOPL003
     3INCROSS,IVSPIN,ELO,TEFF,DELTA,E,AWR                               DOPL004
      DIMENSION ARAY(6,500),IRAY(3,500),ERAY(2,500),NOT(20),ZAI(10),    DOPL005
     1ABN(10),NER(10),LFW(10),EL(10,10),EH(10,10),LRU(10,10),LRF(10,10),DOPL006
     2LANG(10,5,5),NLS(10,10),NRES(10),LN(50),JN(150),PENFAR(500),      DOPL007
     3SHIFAR(500),SPI(10),AP(10),AWRI(10),AM(10),DREF(6),AREF(6),BREF(6,DOPL008
     410)                                                               DOPL009
      TEF=TEFF/293.0                                                    DOPL010
      TERM=0.0                                                          DOPL011
      CALL SIGMA(X,IRANGE)                                              DOPL012
      DO 100 I=1,NIS                                                    DOPL013
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      XWR=AWRI(I)                                                       DOPL014
      CELTA=(0.3177E+00)*SQRT((TEF*E)/XWR)                              DOPL015
      Z=(E-X)/CELTA                                                     DOPL016
      Z2=Z*Z                                                            DOPL017
      T1=BREF(INCROSS,I)*EXP(-Z2)/(CELTA*1.772454)                      DOPL018
      TERM=TERM+T1                                                      DOPL019
  100 CONTINUE                                                          DOPL020
      DOPPLER=TERM                                                      DOPL021
      RETURN                                                            DOPL022
      END                                                               DOPL023
      SUBROUTINE SIGMA(Q,KK)                                            SIGM001
      COMMON/E/XMIN(6),XMAX(6),XREF(6)                                  SIGM002
      COMMON ARAY,IRAY,ERAY,NOT,ZAI,ABN,NER,LFW,EL,EH,LRU,LRF,LANG,NLS, SIGM003
     1NRES,LN,JN,PENFAR,SHIFAR,SPI,AP,AWRI,AM,DREF,AREF,BREF,IRANGE,NIS,SIGM004
     3INCROSS,IVSPIN,ELO,TEFF,DELTA,E,AWR                               SIGM005
      DIMENSION ARAY(6,500),IRAY(3,500),ERAY(2,500),NOT(20),ZAI(10),    SIGM006
     1ABN(10),NER(10),LFW(10),EL(10,10),EH(10,10),LRU(10,10),LRF(10,10),SIGM007
     2LANG(10,5,5),NLS(10,10),NRES(10),LN(50),JN(150),PENFAR(500),      SIGM008
     3SHIFAR(500),SPI(10),AP(10),AWRI(10),AM(10),DREF(6),AREF(6),BREF(6,SIGM009
     410)                                                               SIGM010
      PI=3.14159265359                                                  SIGM011
      DO 4 J=1,6                                                        SIGM012
      AREF(J)=0.0                                                       SIGM013
      DO 5 K=1,10                                                       SIGM014
      BREF(J,K)=0.0                                                     SIGM015
    5 CONTINUE                                                          SIGM016
    4 CONTINUE                                                          SIGM017
      TERROR=1.0E-03                                                    SIGM018
      L2=0                                                              SIGM019
      N2=0                                                              SIGM020
      LA=0                                                              SIGM021
      JA=0                                                              SIGM022
      NTR=0                                                             SIGM023
      DO 112 I=1,NIS                                                    SIGM024
      NRESI=NRES(I)                                                     SIGM025
      API=AP(I)                                                         SIGM026
      XWR=AWRI(I)                                                       SIGM027
      YWR=XWR*1.008665                                                  SIGM028
      YWR=YWR**(1.0/3.0)                                                SIGM029
      APX=0.123*YWR+0.08                                                SIGM030
    3 NTR=NTR+NRESI                                                     SIGM031
      IF(NRESI)110,110,100                                              SIGM032
  100 LA=LA+1                                                           SIGM033
  102 L2=L2+LN(LA)                                                      SIGM034
      CALL FACTS(Q,IRAY(1,L2),PF,SF,PX,CONSTE,XWR,APX,3,0)              SIGM035
      CALL FACTS(Q,IRAY(1,L2),PX,SX,PS,CONSTE,XWR,API,3,0)              SIGM036
      SNGLN=0.0                                                         SIGM037
      SNGLG=0.0                                                         SIGM038
      SNGLF=0.0                                                         SIGM039
      SNNL2=0.0                                                         SIGM040
  103 JA=JA+1                                                           SIGM041
  104 N1=N2+1                                                           SIGM042
      N2=N2+JN(JA)                                                      SIGM043
      GJ=2.0*(2.0*SPI(I)+1.0)                                           SIGM044
      GJ=(2.0*ARAY(2,N1)+1.0)/GJ                                        SIGM045
      X=1.0                                                             SIGM046
      SPIN=ARAY(2,N1)                                                   SIGM047
       SPII=SPI(I)                                                      SIGM048
      CALL SPINOR(SPII,IRAY(1,L2),XSPIN)                                SIGM049
      ABDIF=ABS (XSPIN-SPIN)                                            SIGM050
      IF(IVSPIN.EQ.1)GO TO 115                                          SIGM051
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      GO TO 116                                                          SIGM0511
  116 IF(ABDIF.LT.TERROR)GO TO 117                                       SIGM0512
      GO TO 115                                                          SIGM0521
  117 X=0.0                                                              SIGM0531
  115 SNNK23=0.0                                                         SIGM0541
      DO 108 K=N1,N2                                                     SIGM0551
      GNK=PF*ARAY(4,K)/PENFAR(K)                                         SIGM0561
      GK=GNK*ARAY(5,K)*ARAY(6,K)                                         SIGM0571
      ERDK=ARAY(1,K)+((SHIFAR(K)-SF)*ARAY(4,K))/(2.0*PENFAR(K))          SIGM0581
      ED=Q-ERDK                                                          SIGM0591
      DK=ED*ED+0.25*GK*GK                                                SIGM0601
      SNNK2=GNK*GNK*COS (2.0*PS)                                         SIGM0611
      SNNK2=SNNK2-2.0*GNK*(ARAY(5,K)+ARAY(6,K))*SIN(PS)*SIN(PS)          SIGM0621
      SNNK2=SNNK2+2.0*GNK*ED*SIN (2.0*PS)                                SIGM0631
      SNNK2=SNNK2/DK                                                     SIGM0641
      SNGK=GNK*ARAY(5,K)/DK                                              SIGM0651
      SNFK=GNK*ARAY(4,K)/DK                                              SIGM0661
      SNGLN=SNGLN+SNNK2*GJ                                               SIGM0671
      SNGLG=SNGLG+SNGK*GJ                                                SIGM0681
      SNGLF=SNGLF+SNFK*GJ                                                SIGM0691
      SNNK3=0.0                                                          SIGM0701
      IF(K-N1)107,107,105                                                SIGM0711
  105 M1=K-1                                                             SIGM0721
      DO 106 M=N1,M1                                                     SIGM0731
      GNM=PF*ARAY(4,M)/PENFAR(M)                                         SIGM0741
      GM=GNM*ARAY(5,M)*ARAY(6,M)                                         SIGM0751
      ERDM=ARAY(1,M)+((SHIFAR(M)-SF)*ARAY(4,M))/(2.0*PENFAR(M))          SIGM0761
      EDD=Q-ERDM                                                         SIGM0771
      DM=EDD*EDD+0.25*GM*GM                                              SIGM0781
      SNNM3=ED*EDD+0.25*GK*GM                                            SIGM0791
      SNNM3=SNNM3*2.0*GNK*GNM/(DM*DK)                                    SIGM0801
      SNNK3=SNNK3+SNNM3                                                  SIGM0811
  106 CONTINUE                                                           SIGM0821
  107 CONTINUE                                                           SIGM0831
      SNNK23=SNNK23+SNNK2+SNNK3*X                                        SIGM0841
  108 CONTINUE                                                           SIGM0851
      SNNL2=SNNL2+SNNK23*GJ                                              SIGM0861
      IF(L2-N2)109,109,103                                               SIGM0871
  109 BETA=PI*ABN(I)/(CONSTE*CONSTE)                                     SIGM0881
       AREF(1)=AREF(1)+SNGLN*BETA                                        SIGM0891
      AREF(2)=AREF(2)+SNGLG*BETA                                         SIGM0901
      AREF(3)=AREF(3)+SNGLF*BETA                                         SIGM0911
      AREF(4)=AREF(4)+BETA*(SNGLN+SNGLG+SNGLF)                           SIGM0921
      AREF(5)=AREF(5)+SNNL2*BETA                                         SIGM0931
      AREF(6)=AREF(6)+BETA*(SNGLG+SNGLF+SNNL2)                           SIGM0941
      BREF(1,I)=SNGLN*BETA +BREF(1,I)                                    SIGM0951
      BREF(2,I)=SNGLG*BETA+BREF(2,I)                                     SIGM0961
      BREF(3,I)=SNGLF*BETA+BREF(3,I)                                     SIGM0971
      BREF(4,I)=BETA*(SNGLN+SNGLG+SNGLF)+BREF(4,I)                       SIGM0981
      BREF(5,I)=SNNL2*BETA+BREF(5,I)                                     SIGM0991
      BREF(6,I)=BETA*(SNGLG+SNGLF+SNNL2)+BREF(6,I)                       SIGM1101
      IF(L2-NTR)100,110,110                                              SIGM1111
  110 SIGP=0.0                                                           SIGM1121
      LRUJK=LRU(I,KK)                                                    SIGM1131
      IF(LRUJK-1)1250,1250,125                                           SIGM1141
 1250 NLSKK=NLS(I,KK)                                                    SIGM1151
      DO 126 LL=1,NLSKK                                                  SIGM1161
      LURE=LANG(I,KK,LL)                                                 SIGM1171
      SS=FLOAT (LURE)                                                    SIGM1181
      CALL FACTS(Q,LURE,PF,SF,PS,CONSTA,XWR,API,3,0)                     SIGM1191
      TRM=(2.0*SS+1.0)*4.0*PI                                            SIGM1201
```

```
      TRM=TRM*SIN(PS)*SIN(PS)/(CONSTA*CONSTA)                          SIGM121
      SIGP=SIGP+TRM                                                    SIGM122
  126 CONTINUE                                                         SIGM123
  125 AREF(1)=AREF(1)+SIGP*ABN(I)                                      SIGM124
      AREF(4)=AREF(4)+SIGP*ABN(I)                                      SIGM125
      AREF(5)=AREF(5)+SIGP*ABN(I)                                      SIGM126
      AREF(6)=AREF(6)+SIGP*ABN(I)                                      SIGM127
      BREF(1,I)=BREF(1,I)+SIGP*ABN(I)                                  SIGM128
      BREF(4,I)=BREF(4,I)+SIGP*ABN(I)                                  SIGM129
      BREF(5,I)=BREF(5,I)+SIGP*ABN(I)                                  SIGM130
      BREF(6,I)=BREF(6,I)+SIGP*ABN(I)                                  SIGM131
  112 CONTINUE                                                         SIGM132
      RETURN                                                           SIGM133
      END                                                              SIGM134
      SUBROUTINE SIEVE(E1,G1,E2,G2,M,N,NX,BEFF,BWR)                    SIEV001
      COMMON/C/EX(101),JFLAG(101)                                      SIEV002
      IF(E2.LT.E1)GO TO 101                                            SIEV003
      GO TO 300                                                        SIEV0031
  300 N2=2*N                                                           SIEV004
      DO 1000 I=1,100                                                  SIEV005
      JFLAG(I)=2                                                       SIEV006
 1000 CONTINUE                                                         SIEV007
      TEF=BEFF/293.0                                                   SIEV008
      DP=(1.5885E+00)*SQRT (TEF/BWR)                                   SIEV009
C     WHEN MULTIPLIED BY SQRT(E) DP GIVES 5 TIMES CORRESPONDING DELTA  SIEV010
      DP1=DP*SQRT(E1)                                                  SIEV011
      DP2=DP*SQRT (E2)                                                 SIEV012
      DG1=G1/FLOAT (M)                                                 SIEV013
      DG2=G2/FLOAT (M)                                                 SIEV014
      EX(1)=E1                                                         SIEV015
      IF(G1.LT.DP1)GO TO 1001                                          SIEV016
      GO TO 1002                                                       SIEV0161
 1001 JFLAG(1)=1                                                       SIEV017
 1002 ENDIF=ABS (E2-E1)                                                SIEV018
      NX=1                                                             SIEV019
      DO 100 I=1,N                                                     SIEV020
      XX=E1+DG1*FLOAT (I)                                              SIEV021
      IF(XX.LT.E2)GO TO 107                                            SIEV022
      GO TO 100                                                        SIEV0221
  107 NX=NX+1                                                          SIEV023
      EX(NX)=XX                                                        SIEV024
      IF(G1.LT.DP1)GO TO 1003                                          SIEV025
      GO TO 100                                                        SIEV0251
 1003 JFLAG(NX)=1                                                      SIEV026
  100 CONTINUE                                                         SIEV027
      DO 200 I=1,N                                                     SIEV028
      XX=E2-DG2*FLOAT (I)                                              SIEV029
      IF(XX.GT.E1)GO TO 108                                            SIEV030
      GO TO 200                                                        SIEV0301
  108 NX=NX+1                                                          SIEV031
      EX(NX)=XX                                                        SIEV032
      IF(G2.LT.DP2)GO TO 1005                                          SIEV033
      GO TO 200                                                        SIEV0331
 1005 JFLAG(NX)=1                                                      SIEV034
  200 CONTINUE                                                         SIEV035
  110 DIFF=(E2-E1)/FLOAT (N2)                                          SIEV036
      IF(DIFF)101,102,102                                              SIEV037
  101 PRINT103                                                         SIEV038
      PRINT2000,E1,E2,DIFF                                             SIEV039
      GO TO 104                                                        SIEV040
  103 FORMAT(32H CALLING SEQUENCE OF SIEVE WRONG)                      SIEV041
```

```
2000 FORMAT(4H E1=E13,6,4H E2=E13,6,6H DIFF=E13,6)                    SIEV042
 102 N21=NX+1                                                        SIEV043
     NN=NX                                                           SIEV044
     N22=N21+N2-2                                                    SIEV045
     NX=N22                                                          SIEV046
     E21=(E1+E2)/2,0                                                 SIEV047
     DP12=DP*SQRT (E21)                                              SIEV048
     E43=E2-E1-((G1+G2)/2,0)                                         SIEV049
     IF(E43,LT,DP12)GO TO 1006                                       SIEV050
     GO TO 1007                                                      SIEV0501
1006 DO 111 I=N21,N22                                                SIEV051
     I2=I-NN                                                         SIEV052
     EX(I)=E1+DIFF*FLOAT (I2)                                        SIEV053
     JFLAG(I)=1                                                      SIEV054
 111 CONTINUE                                                        SIEV055
     GO TO 1040                                                      SIEV056
1007 DO 112 I=N21,N22                                                SIEV057
     I2=I-NN                                                         SIEV058
     EX(I)=E1+DIFF*FLOAT (I2)                                        SIEV059
     DPTEST=DP*SQRT (EX(I))                                          SIEV060
     IF(EX(I),LE,E21)GO TO 1008                                      SIEV061
     GO TO 1009                                                      SIEV0611
1008 IF(G1.LT.DPTEST)GO TO 1010                                      SIEV062
     GO TO 112                                                       SIEV0621
1010 JFLAG(I)=1                                                      SIEV063
     GO TO 112                                                       SIEV064
1009 IF(G2.LT.DPTEST)GO TO 1011                                      SIEV065
     GO TO 112                                                       SIEV0651
1011 JFLAG(I)=1                                                      SIEV066
 112 CONTINUE                                                        SIEV067
1040 DO 113 I=1,NX                                                   SIEV068
     DPF=DP*SQRT (EX(I))                                             SIEV069
     IF(DPF,EQ,0,0)GO TO 113                                         SIEV0691
     TERM=EX(I)/DPF                                                  SIEV070
     IF(TERM.LT.25,)GO TO 114                                        SIEV071
     GO TO 113                                                       SIEV0711
 114 JFLAG(I)=1                                                      SIEV072
 113 CONTINUE                                                        SIEV073
 104 RETURN                                                          SIEV074
     END                                                             SIEV075
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SIGMA2 TEST, IRON DATA.                    0 350.    11     2     1.0E-4
  26056.E+055.36724E+0          0                0              4              0
  26054.E+0    .0584E+0         0                0              1              0
   4750.        100.E+3         1                2              0              0
      0.             .6         0                0              2              0
 53.4762           0.0          0                0             78             13
  -15000.         .5E+0    5001.000     5000.          1.00
    7.83E+3       .5E+0    1202.16      1200.E+0  2.16
   52.1 E+3       .5E+0    2100.E+0     2100.E+0       .3E+0
   71.9 E+3       .5E+0    1600.E+0     1600.E+0       .3E+0
   98.5 E+3       .5E+0     400.E+0      400.E+0       .3E+0
  102.6 E+3       .5E+0    1375.E+0     1375.E+0       .3E+0
  132.  E+3       .5E+0    1600.E+0     1600.E+0       .3E+0
  147.  E+3       .5E+0    1950.E+0     1950.E+0       .3E+0
  173.  E+3       .5E+0    4800.E+0     4800.E+0       .3E+0
  188.5 E+3       .5E+0   38000.E+0    38000.E+0       .3E+0
  245.  E+3       .5E+0   13000.E+0    13000.E+0       .3E+0
  330.  E+3       .5E+0    2750.E+0     2750.E+0       .3E+0
  370.  E+3       .5E+0    3000.E+0     3000.E+0       .3E+0
 53.4762             0.             1            0             12              2
   9480.             .5       2.04         1.04        1.0
  14400.             .5       2.13         1.13        1.0
  26056.E+0    .9168E+0         0                0              1              0
   4750.        100.E+3         1                2              0              0
     0.E+0       .60E+0         0                0              2              0
 55.4544           0.0          0                0             90             15
    -4000.           .5     576.01       575.          1.01
  27700.             .5    1401.44      1400.          1.44
   74.  E+3       .5E+0     425.E+0      425.E+0        1.E+0
   83.6 E+3       .5E+0    1000.E+0     1000.E+0        1.E+0
  123.5 E+3       .5E+0     150.E+0      150.E+0        1.E+0
  130.  E+3       .5E+0     500.E+0      500.E+0        1.E+0
  141.3 E+3       .5E+0    2300.E+0     2300.E+0        1.E+0
  169.  E+3       .5E+0     690.E+0      690.E+0        1.E+0
  188.  E+3       .5E+0    3160.E+0     3160.E+0        1.E+0
  220.  E+3       .5E+0    1300.E+0     1300.E+0        1.E+0
  243.5 E+3       .5E+0     300.E+0      300.E+0        1.E+0
  273.  E+3       .5E+0    3500.E+0     3500.E+0        1.E+0
  315.  E+3       .5E+0    5500.E+0     5500.E+0        1.E+0
  360.  E+3       .5E+0    9300.E+0     9300.E+0        1.E+0
  382.  E+3       .5E+0   10000.E+0    10000.E+0        1.E+0
 55.4544           0.0             1            0             72             12
   1150.             .5        .616         .052         .564
   2350.             .5      1.0004         .0004        1.
  11200.            1.5       1.022         .022         1.
  22700.            1.5      1.1055         .1055        1.
  34100.            1.5       2.346         .346         2.
  36600.             .5        1.43         .43          1.
  38300.            1.5       1.298         .298         1.
  45800.             .5       2.381         .381         2.
  51900.             .5       2.685         .685         2.
  53300.            1.5        1.37         .37          1.
  55000.             .5      1.1625         .1625        1.
  59000.             .5        2.74         .74          2.
  26057.E+0 .021700E+0          0                0              1              0
   4750.        100.E+3         1                2              0              0
       .5             .6         0                0              2              0
 56.4463           0.0          0                0             30              5
   3900.           0.0      241.5        240.          1.5
   6300.           1.0      463.73       460.          3.73
  28000.       1.        3005.        3000.       5.
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 40500.          0.   2516.83     2516.          .83
 45500.          1.    269.83      269.          .83
56.4463          0.0          1             0          48          8
  1630.          0.       1.08          .25          .83
  4750.          0.      1.086          .256         .83
  7220.          1.      1.753          .923         .83
  7900.          1.      1.146          .316         .83
 12800.          2.      1.336          .506         .83
 13900.          2.      2.426          .776        1.65
 18000.          1.       2.71         1.06         1.65
 21300.          1.       6.92         1.92           5.
 26058.E+0   .0031E+0          0            0            1          0
  4750.       100.E+3          1            2            0          0
     0.E+0     .60E+0          0            0            2          0
57.4356          0.0          0            0            6          1
    -600.          .5       3.57         2.57       1.00
57.4356          0.0          1            0           12          2
   230.            .5    1.00654      .00654           1.
   359.            .5     1.0173       .0173           1.
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PROGRAM SIGMA2, PROGRAM TO CALCULATE SINGLE OR MULTILEVEL BREIT-WIGNER CROSS-SECTIONS, USES ENDF/B VERSION II DATA

TITLE SIGMA2 TEST, IRON DATA.

(Z,A) DESIGNATION OF THE ELEMENT 2.6056E+04 AT.WT/MASS OF NEUTRON 5.5367E+01 NO OF ISOTOPES 4

DATA FOR ISOTOPE NUMBER 1

(Z,A) DESIGNATION OF THE ISOTOPE 2.6054E+04 FRACTIONAL ABUNDANCE 5.8400E-02 NO OF ENERGY RANGES 1
LOWER LIMIT OF THE ENERGY RANGE(EV) 4.7500E+03 UPPER LIMIT(EV) 1.0000E+05 LRU= 1 LRF= 2
NUCLEAR SPIN 0.0000E+00 SCATTERING LENGTH 6.0000E-01 NO OF L-VALUES 2
MASS OF THE ISOTOPE IN UNITS OF NEUTRON MASS 5.3476E+01 SCATTERING LENGTH(A-) 0.0000E+00 ANGULAR MOMENTUM 0 NO OF RESONANCES 13

ERES	SPIN	GTOT	GN	GGAMMA	GF
-1.5000E+04	5.0000E-01	5.0010E+03	5.0000E+03	1.0000E+00	0.0000E+00
7.8300E+03	5.0000E-01	1.2022E+03	1.2000E+03	2.1600E+00	0.0000E+00
5.2100E+04	5.0000E-01	2.1000E+03	2.1000E+03	3.0000E-01	0.0000E+00
7.1900E+04	5.0000E-01	1.6000E+03	1.6000E+03	3.0000E-01	0.0000E+00
9.8500E+04	5.0000E-01	4.0000E+02	4.0000E+02	3.0000E-01	0.0000E+00
1.0260E+05	5.0000E-01	1.3750E+03	1.3750E+03	3.0000E-01	0.0000E+00
1.3200E+05	5.0000E-01	1.6000E+03	1.6000E+03	3.0000E-01	0.0000E+00
1.4700E+05	5.0000E-01	1.9500E+03	1.9500E+03	3.0000E-01	0.0000E+00
1.7300E+05	5.0000E-01	4.8000E+03	4.8000E+03	3.0000E-01	0.0000E+00
1.8850E+05	5.0000E-01	3.8000E+04	3.8000E+04	3.0000E-01	0.0000E+00
2.4500E+05	5.0000E-01	1.3000E+04	1.3000E+04	3.0000E-01	0.0000E+00
3.3000E+05	5.0000E-01	2.7500E+03	2.7500E+03	3.0000E-01	0.0000E+00
3.7000E+05	5.0000E-01	3.0000E+03	3.0000E+03	3.0000E-01	0.0000E+00

MASS OF THE ISOTOPE IN UNITS OF NEUTRON MASS 5.3476E+01 SCATTERING LENGTH(A-) 0.0000E+00 ANGULAR MOMENTUM 1 NO OF RESONANCES 2

ERES	SPIN	GTOT	GN	GGAMMA	GF
9.4800E+03	5.0000E-01	2.0400E+00	1.0400E+00	1.0000E+00	0.0000E+00
1.4400E+04	5.0000E-01	2.1300E+00	1.1300E+00	1.0000E+00	0.0000E+00

DATA FOR ISOTOPE NUMBER 2

(Z,A) DESIGNATION OF THE ISOTOPE 2.6056E+04 FRACTIONAL ABUNDANCE 9.1680E-01 NO OF ENERGY RANGES 1

LOWER LIMIT OF THE ENERGY RANGE(EV) 4,7500E+03 UPPER LIMIT(EV) 1,0000E+05 LRU= 1 LRF= 2
NUCLEAR SPIN 0,0000E+00 SCATTERING LENGTH 6,0000E-01 NO OF L-VALUES 2
MASS OF THE ISOTOPE IN UNITS OF NEUTRON MASS 5,5454E+01 SCATTERING LENGTH(A=) 0,0000E+00 ANGULAR MOMENTUM 0 NO OF RESONANCES 15

ERES	SPIN	GTOT	GN	GGAMMA	GF
-4,0000E+03	5,0000E-01	5,7601E+02	5,7500E+02	1,0100E+00	0,0000E+00
2,7700E+04	5,0000E-01	1,4014E+03	1,4000E+03	1,4400E+00	0,0000E+00
7,4000E+04	5,0000E-01	4,2500E+02	4,2500E+02	1,0000E+00	0,0000E+00
8,3600E+04	5,0000E-01	1,0000E+03	1,0000E+03	1,0000E+00	0,0000E+00
1,2350E+05	5,0000E-01	1,5000E+02	1,5000E+02	1,0000E+00	0,0000E+00
1,3000E+05	5,0000E-01	5,0000E+02	5,0000E+02	1,0000E+00	0,0000E+00
1,4130E+05	5,0000E-01	2,3000E+03	2,3000E+03	1,0000E+00	0,0000E+00
1,6900E+05	5,0000E-01	6,9000E+02	6,9000E+02	1,0000E+00	0,0000E+00
1,8800E+05	5,0000E-01	3,1600E+03	3,1600E+03	1,0000E+00	0,0000E+00
2,2000E+05	5,0000E-01	1,3000E+03	1,3000E+03	1,0000E+00	0,0000E+00
2,4350E+05	5,0000E-01	3,0000E+02	3,0000E+02	1,0000E+00	0,0000E+00
2,7300E+05	5,0000E-01	3,5000E+03	3,5000E+03	1,0000E+00	0,0000E+00
3,1500E+05	5,0000E-01	5,5000E+03	5,5000E+03	1,0000E+00	0,0000E+00
3,6000E+05	5,0000E-01	9,3000E+03	9,3000E+03	1,0000E+00	0,0000E+00
3,8200E+05	5,0000E-01	1,0000E+04	1,0000E+04	1,0000E+00	0,0000E+00

MASS OF THE ISOTOPE IN UNITS OF NEUTRON MASS 5,5454E+01 SCATTERING LENGTH(A=) 0,0000E+00 ANGULAR MOMENTUM 1 NO OF RESONANCES 12

ERES	SPIN	GTOT	GN	GGAMMA	GF
1,1500E+03	5,0000E-01	6,1600E-01	5,2000E-02	5,6400E-01	0,0000E+00
2,3500E+03	5,0000E-01	1,0004E+00	4,0000E-04	1,0000E+00	0,0000E+00
1,1200E+04	1,5000E+00	1,0220E+00	2,2000E-02	1,0000E+00	0,0000E+00
2,2700E+04	1,5000E+00	1,1055E+00	1,0550E-01	1,0000E+00	0,0000E+00
3,4100E+04	1,5000E+00	2,3460E+00	3,4600E-01	2,0000E+00	0,0000E+00
3,6600E+04	5,0000E-01	1,4300E+00	4,3000E-01	1,0000E+00	0,0000E+00
3,8300E+04	1,5000E+00	1,2980E+00	2,9800E-01	1,0000E+00	0,0000E+00
4,5800E+04	5,0000E-01	2,3810E+00	3,8100E-01	2,0000E+00	0,0000E+00
5,1900E+04	5,0000E-01	2,6850E+00	6,8500E-01	2,0000E+00	0,0000E+00
5,3300E+04	1,5000E+00	1,3700E+00	3,7000E-01	1,0000E+00	0,0000E+00
5,5000E+04	5,0000E-01	1,1625E+00	1,6250E-01	1,0000E+00	0,0000E+00
5,9000E+04	5,0000E-01	2,7400E+00	7,4000E-01	2,0000E+00	0,0000E+00

DATA FOR ISOTOPE NUMBER 3

(Z,A) DESIGNATION OF THE ISOTOPE 2,6057E+04 FRACTIONAL ABUNDANCE 2,1700E-02 NO OF ENERGY RANGES 1
LOWER LIMIT OF THE ENERGY RANGE(EV) 4,7500E+03 UPPER LIMIT(EV) 1,0000E+05 LRU= 1 LRF= 2
NUCLEAR SPIN 5,0000E-01 SCATTERING LENGTH 6,0000E-01 NO OF L-VALUES 2
MASS OF THE ISOTOPE IN UNITS OF NEUTRON MASS 5,6446E+01 SCATTERING LENGTH(A=) 0,0000E+00 ANGULAR MOMENTUM 0 NO OF RESONANCES 5

ERES	SPIN	GTOT	GN	GGAMMA	GF
3,9000E+03	0,0000E+00	2,4150E+02	2,4000E+02	1,5000E+00	0,0000E+00

6,3000E+03	1,0000E+00	4,6373E+02	4,6000E+02	3,7300E+00	0,0000E+00
2,8000E+04	1,0000E+00	3,0050E+03	3,0000E+03	5,0000E+00	0,0000E+00
4,0500E+04	0,0000E+00	2,5168E+03	2,5160E+03	8,3000E-01	0,0000E+00
4,5500E+04	1,0000E+00	2,6983E+02	2,6900E+02	8,3000E-01	0,0000E+00

MASS OF THE ISOTOPE IN UNITS OF NEUTRON MASS 5,6446E+01 SCATTERING LENGTH(A-) 0,0000E+00 ANGULAR MOMENTUM 1 NO OF RESONANCES 8

ERES	SPIN	GTOT	GN	GGAMMA	GF
1,6300E+03	0,0000E+00	1,0800E+00	2,5000E-01	8,3000E-01	0,0000E+00
4,7500E+03	0,0000E+00	1,0860E+00	2,5600E-01	8,3000E-01	0,0000E+00
7,2200E+03	1,0000E+00	1,7530E+00	9,2300E-01	8,3000E-01	0,0000E+00
7,9000E+03	1,0000E+00	1,1460E+00	3,1600E-01	8,3000E-01	0,0000E+00
1,2800E+04	2,0000E+00	1,3360E+00	5,0600E-01	8,3000E-01	0,0000E+00
1,3900E+04	2,0000E+00	2,4260E+00	7,7600E-01	1,6500E+00	0,0000E+00
1,8000E+04	1,0000E+00	2,7100E+00	1,0600E+00	1,6500E+00	0,0000E+00
2,1300E+04	1,0000E+00	6,9200E+00	1,9200E+00	5,0000E+00	0,0000E+00

DATA FOR ISOTOPE NUMBER 4

(Z,A) DESIGNATION OF THE ISOTOPE 2,6058E+04 FRACTIONAL ABUNDANCE 3,1000E-03 NO OF ENERGY RANGES 1
LOWER LIMIT OF THE ENERGY RANGE(EV) 4,7500E+03 UPPER LIMIT(EV) 1,0000E+05 LRU= 1 LRF= 2
NUCLEAR SPIN 0,0000E+00 SCATTERING LENGTH 6,0000E-01 NO OF L-VALUES 2
MASS OF THE ISOTOPE IN UNITS OF NEUTRON MASS 5,7436E+01 SCATTERING LENGTH(A-) 0,0000E+00 ANGULAR MOMENTUM 0 NO OF RESONANCES 1

ERES	SPIN	GTOT	GN	GGAMMA	GF
-6,0000E+02	5,0000E-01	3,5700E+00	2,5700E+00	1,0000E+00	0,0000E+00

MASS OF THE ISOTOPE IN UNITS OF NEUTRON MASS 5,7436E+01 SCATTERING LENGTH(A-) 0,0000E+00 ANGULAR MOMENTUM 1 NO OF RESONANCES 2

ERES	SPIN	GTOT	GN	GGAMMA	GF
2,3000E+02	5,0000E-01	1,0065E+00	6,5400E-03	1,0000E+00	0,0000E+00
3,5900E+02	5,0000E-01	1,0173E+00	1,7300E-02	1,0000E+00	0,0000E+00

CROSS-SECTIONS AT THERMAL ENERGY

NEUTRON ENERGY(EV)	SIGNN	SIGCAP	SIGF	SIGT	SIGNNMULT	SIGTMULT
2,530000E-02	1,336535E+01	2,523121E+00	0,000000E+00	1,588847E+01	1,137350E+01	1,389662E+01

NEUTRON ENERGY(EV)	SIGNN	SIGCAP	SIGF	SIGT	SIGNNMULT	SIGTMULT
4,750000E+03	6.786218E+00	5.598969E-01	0,000000E+00	7,346115E+00	5,693567E+00	6,253464E+00
4,981865E+03	6.502924E+00	5.413977E-03	0,000000E+00	6,508338E+00	5,432383E+00	5,437797E+00
5,137500E+03	6.466145E+00	5.974332E-03	0,000000E+00	6,472119E+00	5,410671E+00	5,416645E+00
5,213730E+03	6.461260E+00	6.344211E-03	0,000000E+00	6,467604E+00	5,413503E+00	5,419848E+00
5,525000E+03	6.581146E+00	8.971746E-03	0,000000E+00	6,590118E+00	5,570591E+00	5,579563E+00
5,836270E+03	7.276019E+00	1.642974E-02	0,000000E+00	7,292449E+00	6,323516E+00	6,339946E+00
5,912500E+03	7.694269E+00	2.030127E-02	0,000000E+00	7,714571E+00	6,760353E+00	6,780655E+00
6,068135E+03	9.350635E+00	3.430841E-02	0,000000E+00	9,384944E+00	8,444000E+00	8,478308E+00
6,300000E+03	1.367694E+01	6.214332E-02	0,000000E+00	1,373908E+01	1,252778E+01	1,258993E+01
6,530000E+03	1.153929E+01	3.518072E-02	0,000000E+00	1,157447E+01	1,013309E+01	1,016827E+01
6,531865E+03	1.151864E+01	3.497615E-02	0,000000E+00	1,155362E+01	1,011221E+01	1,014719E+01
6,760000E+03	1.040049E+01	2.129222E-02	0,000000E+00	1,042178E+01	9,016798E+00	9,038091E+00
6,763730E+03	1.040148E+01	2.120134E-02	0,000000E+00	1,042268E+01	9,018405E+00	9,039606E+00
6,990000E+03	1.129585E+01	1.964598E-02	0,000000E+00	1,131549E+01	9,952143E+00	9,971789E+00
7,218247E+03	1.416031E+01	3.259774E-01	0,000000E+00	1,448628E+01	1,288619E+01	1,321217E+01
7,219123E+03	1.467864E+01	7.805316E-01	0,000000E+00	1,545917E+01	1,340493E+01	1,418547E+01
7,220000E+03	1.553666E+01	1.538838E+00	0,000000E+00	1,707550E+01	1,426337E+01	1,580221E+01
7,220876E+03	1.470816E+01	7.805198E-01	0,000000E+00	1,548868E+01	1,343528E+01	1,421580E+01
7,221753E+03	1.421574E+01	3.260880E-01	0,000000E+00	1,454183E+01	1,294327E+01	1,326936E+01
7,228920E+03	1.400368E+01	3.791072E-02	0,000000E+00	1,404159E+01	1,273465E+01	1,277256E+01
7,372500E+03	1.657625E+01	2.764881E-02	0,000000E+00	1,660390E+01	1,540332E+01	1,543097E+01
7,525000E+03	1.998824E+01	3.282913E-02	0,000000E+00	2,002107E+01	1,899490E+01	1,902773E+01
7,677500E+03	2.331014E+01	3.711650E-02	0,000000E+00	2,334725E+01	2,258919E+01	2,262631E+01
7,830000E+03	2.513752E+01	3.810985E-02	0,000000E+00	2,517563E+01	2,473374E+01	2,477185E+01
7,847500E+03	2.519689E+01	3.798863E-02	0,000000E+00	2,523488E+01	2,482780E+01	2,486579E+01
7,865000E+03	2.522289E+01	3.791625E-02	0,000000E+00	2,526081E+01	2,488755E+01	2,492546E+01
7,882500E+03	2.521602E+01	3.851254E-02	0,000000E+00	2,525453E+01	2,491332E+01	2,495183E+01
7,898854E+03	2.526331E+01	2.588650E-01	0,000000E+00	2,552218E+01	2,499001E+01	2,524887E+01
7,899427E+03	2.538810E+01	5.916923E-01	0,000000E+00	2,597979E+01	2,511580E+01	2,570750E+01
7,900000E+03	2.559837E+01	1.146621E+00	0,000000E+00	2,674499E+01	2,532708E+01	2,647370E+01
7,900573E+03	2.538605E+01	5.916741E-01	0,000000E+00	2,597772E+01	2,511576E+01	2,570744E+01
7,901146E+03	2.525729E+01	2.588180E-01	0,000000E+00	2,551611E+01	2,498801E+01	2,524683E+01
8,295000E+03	1.921428E+01	2.255651E-02	0,000000E+00	1,923683E+01	1,925329E+01	1,927584E+01
8,690000E+03	1.336351E+01	1.200501E-02	0,000000E+00	1,337551E+01	1,331083E+01	1,332283E+01
9,085000E+03	1.020825E+01	7.084410E-03	0,000000E+00	1,021533E+01	1,004417E+01	1,005125E+01
9,477960E+03	9.328068E+00	8.359765E-01	0,000000E+00	1,016405E+01	9,088678E+00	9,924655E+00
9,478980E+03	1.062111E+01	2.083741E+00	0,000000E+00	1,270485E+01	1,038167E+01	1,246541E+01
9,480000E+03	1.278791E+01	4.164793E+00	0,000000E+00	1,695270E+01	1,254779E+01	1,671258E+01
9,481020E+03	1.062600E+01	2.083611E+00	0,000000E+00	1,270962E+01	1,038520E+01	1,246881E+01
9,482040E+03	9.323898E+00	8.360245E-01	0,000000E+00	1,015992E+01	9,083046E+00	9,919071E+00
9,910000E+03	7.315977E+00	3.245635E-03	0,000000E+00	7,319223E+00	7,024155E+00	7,027400E+00
1,034000E+04	6.567085E+00	2.421979E-03	0,000000E+00	6,569507E+00	6,244069E+00	6,246491E+00
1,077000E+04	6.033419E+00	1.926840E-03	0,000000E+00	6,035346E+00	5,691969E+00	5,693896E+00
1,119898E+04	5.662268E+00	1.862818E+00	0,000000E+00	7,525086E+00	5,310626E+00	7,173443E+00
1,119949E+04	5.721642E+00	4.654700E+00	0,000000E+00	1,037634E+01	5,369999E+00	1,002470E+01
1,120000E+04	5.831645E+00	9.307759E+00	0,000000E+00	1,513940E+01	5,479952E+00	1,478771E+01
1,120051E+04	5.736932E+00	4.654891E+00	0,000000E+00	1,039182E+01	5,385189E+00	1,004008E+01
1,120102E+04	5.673472E+00	1.862977E+00	0,000000E+00	7,536449E+00	5,321729E+00	7,184705E+00
1,160000E+04	5.321577E+00	1.382423E-03	0,000000E+00	5,322959E+00	4,965281E+00	4,966664E+00
1,200000E+04	5.063725E+00	1.214665E-03	0,000000E+00	5,064939E+00	4,706132E+00	4,707347E+00
1,240000E+04	4.839667E+00	1.098849E-03	0,000000E+00	4,840765E+00	4,483155E+00	4,484254E+00
1,279866E+04	4.803067E+00	2.698693E-01	0,000000E+00	5,072936E+00	4,449910E+00	4,719779E+00
1,279933E+04	5.048263E+00	6.733360E-01	0,000000E+00	5,721599E+00	4,695249E+00	5,368584E+00
1,280000E+04	5.460203E+00	1.345842E+00	0,000000E+00	6,806045E+00	5,106520E+00	6,452362E+00

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C      PROGRAM RAMP1(INPUT,OUTPUT)                                              RMP1001
       COMMON/D/ERAN(2,501)                                                     RMP1002
       COMMON/C/EX(101),JFLAG(101)                                              RMP1003
       COMMON/E/XMIN(6),XMAX(6),XREF(6)                                         RMP1004
       COMMON ARAY,IRAY,ERAY,NOT,ZAI,ABN,NER,LFW,EL,EH,LRU,LRF,LANG,NLS,        RMP1005
      1NRES,LN,JN,PENFAR,SHIFAR,SPI,AP,AWRI,AM,DREF,AREF,BREF,IRANGE,NIS,RMP1006
      3INCROSS,IVSPIN,ELO,TEFF,DELTA,E,AWR                                      RMP1007
       EXTERNAL MOV,KOM                                                         RMP1008
       EXTERNAL MOVE,KOME                                                       RMP1009
       EXTERNAL DOPPLER                                                         RMP1010
       DIMENSION ARAY(6,500),IRAY(3,500),ERAY(2,500),NOT(20),ZAI(10),           RMP1011
      1ABN(10),NER(10),LFW(10),EL(10,10),EH(10,10),LRU(10,10),LRF(10,10),RMP1012
      2LANG(10,5,5),NLS(10,10),NRES(10),LN(50),JN(150),PENFAR(500),             RMP1013
      3SHIFAR(500),SPI(10),AP(10),AWRI(10),AM(10),DREF(6),AREF(6),BREF(6,RMP1014
      410)                                                                      RMP1015
       DIMENSION TITLE(7),XTAB(33)                                              RMP1016
       DATA MAXPTS,MAXRES,ETHERM/2000,100,0,0253/                               RMP1017
C---=-REICH-MOORE FORMALISM USED TO CALCULATE SCATTERING,CAPTURE,FISSIONRMP1018
C-----AND TOTAL CROSS-SECTIONS, RUNS ON CDC-6600 AND PDP-10.                    RMP1019
C---=-THIS PROGRAM MODIFIED ON 30,7,1970 TO INCLUDE NEW FORMAT CHANGES          RMP1020
C---=-GIVING INDIVIDUAL ISOTOPE MASSES AND TWO DIFFERENT NUCLEAR RADII,         RMP1021
C-----THESE FORMAT CHANGES CORRESPOND TO ENDF/B VERSION II DATA.                RMP1022
C      11111111111111111111111111111111111111111111111111111111111111111111RMP1023
             READ1,(TITLE(I),I=1,7),IDPL,TEFF,NTAB,INCROSS,ERROR               RMP1024
C-----IDPL=1 IF DOPPLER BROADENED CROSS-SECTIONS ARE DESIRED,ELSE IDPL=0RMP1025
C-----TEFF=EFFECTIVE TEMPERATURE OF THE TARGET IN DEGREES KELVIN.               RMP1026
C---=-NTAB=NUMBER OF PIVOT POINTS TO BE USED IN EVALUATING THE DOPPLER          RMP1027
C---=-BROADENED CROSS-SECTION, TO GET THE DOPPLER BROADENED CROSS-SECTIORMP1028
C---=-N AT EVERY ENERGY E WE TAKE THE INTERVAL E-N2*DELTA TO E+N2*DELTA RMP1029
C---=-FOR THE INTEGRAL WHERE N2=NTAB/2 AND DELTA IS THE DOPPLER CONSTANTRMP1030
C---=-NTAB=11 OR SO SHOULD SUFFICE FOR ALL CASES, NTAB= ODD INTEGER.           RMP1031
C---=-ERROR=  IF THE RELATIVE ERROR BETWEEN TWO SUCCESSIVE ITERATIONS          RMP1032
C-----OF THE DOPPLER INTEGRAL IS LESS THAN ERROR THE INTEGRATION ROUTINERMP1033
C-=---ASSUMES THAT THE INTEGRAL HAS CONVERGED AND IT EXITS, TYPICAL            RMP1034
C-----VALUES COULD BE=1.0E-04. HOWEVER IT IS RECOMMENDED THAT THE USER         RMP1035
C-----EXERCISE HIS JUDGEMENT IN FEEDING THIS VALUE COMMENSURATE WITH THERMP1036
C---=-ACCURACY OF THE FINAL RESULT DESIRED AND COMPUTER TIME AVAILABLE.        RMP1037
                   PRINT33                                                      RMP1038
                   PRINT25                                                      RMP1039
                   PRINT24,(TITLE(I),I=1,7)                                     RMP1040
       PRINT25                                                                  RMP1041
    1 FORMAT(7A4,2X,I5,F5.1,2I5,E10.4)                                          RMP1042
      IF(IDPL.EQ.1)GO TO 1011                                                   RMP1043
      GO TO 1012                                                                RMP1044
 1011 PRINT25                                                                   RMP1045
      PRINT30,TEFF,NTAB,ERROR,INCROSS                                           RMP1046
      PRINT25                                                                   RMP1047
      GO TO 1013                                                                RMP1048
 1012 CONTINUE                                                                  RMP1049
C      22222222222222222222222222222222222222222222222222222222222222222222RMP1050
 1013              READ3,ZA,AWR,NOT(1),NOT(2),NIS,NOT(3)                       RMP1051
C---=-ZA=(Z,A)DESIGNATION OF MATERIAL,AWR=AT.WT/NEUTRON MASS,NIS=NO OF         RMP1052
C-----ISOTOPES                                                                  RMP1053
                   PRINT17,ZA,AWR,NIS                                           RMP1054
      PRINT25                                                                   RMP1055
      J1=1                                                                      RMP1056
      JFID=1                                                                    RMP1057
      DO 101 I=1,NIS                                                            RMP1058
      NRANGE=1                                                                  RMP1059
C      33333333333333333333333333333333333333333333333333333333333333333333RMP1060
      PRINT25                                                                   RMP1061
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                    PRINT18,I                                                   RMP1062
      PRINT25                                                                   RMP1063
                    READ3,ZAI(I),ABN(I),NOT(4),LFW(I),NER(I),NOT(5)             RMP1064
C---c-ZAI(I)=(Z,A) DESIGNATION OF ITH ISOTOPE ABN(I)=WT FRACTION OF ITH         RMP1065
C---ccISOTOPE LFW=1 FISSION WIDTHS ARE GIVEN,=0 FISSION WIDTHS NOT GIVEN       RMP1066
C---c-NER(I)=NO OF ENERGY RANGES USED                                           RMP1067
                    PRINT19,ZAI(I),ABN(I),NER(I)                                RMP1068
      NERI=NER(I)                                                               RMP1069
      J2=1                                                                      RMP1070
C     4444444444444444444444444444444444444444444444444444444444444444444444RMP1071
  106               READ3,EL(I,J2),EH(I,J2),LRU(I,J2),LRF(I,J2),NOT(6),NORMP1072
     1T(7)                                                                      RMP1073
C-----EL=LOWER ENERGY LIMIT OF A RANGE, EH=UPPER LIMIT OF A RANGE               RMP1074
C-----LRU=1 RESOLVED RESONANCE PARAMETERS,LRU=2 UNRESOLVED  PARAMTRS            RMP1075
C-----LRF INDICATES PARTICULAR TYPE OF RESONANCE FORMULA TO BE USED             RMP1076
                    PRINT20,EL(I,J2),EH(I,J2),LRU(I,J2),LRF(I,J2)               RMP1077
      LRUIJ=LRU(I,J2)                                                           RMP1078
      IF(LRUIJ-1)127,128,1010                                                   RMP1079
  127 PRINT10                                                                   RMP1080
      GO TO 130                                                                 RMP1081
  128 NMOM=1                                                                    RMP1082
C     5555555555555555555555555555555555555555555555555555555555555555555555RMP1083
                    READ3,SPI(I),AP(I),NOT(7),NOT(8),NLS(I,J2),NOT(9)           RMP1084
C---c-SPI(I)=SPIN OF THE I-TH ISOTOPE,AP(I)=A* SPIN DEPENDENT SCATTERINGRMP1085
C-----LENGTH IN UNITS OF 1.0E-12CM.ALSO =SCATTERING LENGTH FOR SPIN INDERMP10851
C---c-PENDENT CASE,NLS=NUMBER OF L VALUES.                                      RMP1086
                    PRINT21,SPI(I),AP(I),NLS(I,J2)                              RMP1087
      JL=1                                                                      RMP1088
C     6666666666666666666666666666666666666666666666666666666666666666666666RMP1089
  104           READ3,AWRI(I),AM(I),LANG(I,J2,JL),NOT(10),NRS6X,NRS           RMP1090
C-----AWRI(I)=MASS OF THE I-TH ISOTOPE IN UNITS OF NEUTRON MASS,AM=A-,          RMP1091
C-----THIS IS SET=0.0 FOR SPIN INDEPENDENT CASE.                                RMP1092
C-----LANG=L-VALUE OF THE ANGULAR MOMENTUM,NRS=NUMBER OF RESONANCES.            RMP1093
                    PRINT22,AWRI(I),AM(I),LANG(I,J2,JL),NRS                     RMP1094
      NMOM=NMOM+1                                                               RMP1095
      J3=J1+(NRS-1)                                                             RMP1096
C     7777777777777777777777777777777777777777777777777777777777777777777777RMP1097
                    READ4,((ARAY(K,J),K=1,6),J=J1,J3)                           RMP1098
C     THIS IS WHERE THE RESONANCE PARAMETERS ARE READ IN, ARAY(1,J)=ERESRMP1099
C     IN EV, ARAY(2,J)=J VALUE,ARAY(3,J)=NEUTRON WIDTH,ARAY(4,J)=GAMMA  RMP1100
C     WIDTH, ARAY(5,J)=FISSION WIDTH OF FIRST FISSION CHANNEL, ARAY(6,J)RMP1101
C     =FISSION WIDTH OF SECOND FISSION CHANNEL. ALL WIDTHS ARE IN EV.           RMP1102
      PRINT25                                                                   RMP1103
                    PRINT23                                                     RMP1104
                    PRINT26,((ARAY(K,J),K=1,6),J=J1,J3)                         RMP1105
      PRINT25                                                                   RMP1106
      DO 102 J=J1,J3                                                            RMP1107
      IRAY(1,J)=LANG(I,J2,JL)                                                   RMP1108
      IRAY(2,J)=NRANGE                                                          RMP1109
      IRAY(3,J)=I                                                               RMP1110
      ERAY(1,J)=SPI(I)                                                          RMP1111
      ERAY(2,J)=AP(I)                                                           RMP1112
  102 CONTINUE                                                                  RMP1113
      J1=J1+NRS                                                                 RMP1114
      JL=JL+1                                                                   RMP1115
      IF(NMOM-NLS(I,J2))104,104,103                                             RMP1116
  103 NRANGE=NRANGE+1                                                           RMP1117
      J2=J2+1                                                                   RMP1118
      IF(NRANGE-NERI)106,106,1010                                               RMP1119
 1010 NRES(I)=J1-JFID                                                           RMP1120
      JFID=J1                                                                   RMP1121
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  101 CONTINUE                                                          RMP1122
      NTOTAL=J1-1                                                       RMP1123
      PHI=3.14159265359                                                 RMP1124
    3 FORMAT(2E11.4,4I11)                                               RMP1125
    4 FORMAT(6E11.4)                                                    RMP1126
    5 FORMAT(8E11.4,3I10)                                               RMP1127
    6 FORMAT(2X,2E11.4)                                                 RMP1128
    7 FORMAT(76H NEUTRON ENERGY(EV)    SIGNN         SIGCAP          SIGRMP1129
     1F          SIGTOTAL)                                              RMP1130
    8 FORMAT(2X,7E15.6)                                                 RMP1131
    9 FORMAT(10X,2E20.6)                                                RMP1132
   10 FORMAT(20H ERROR IN INPUT DATA)                                   RMP1133
   11 FORMAT(10X,2I10)                                                  RMP1134
   12 FORMAT(10X,6I10)                                                  RMP1135
   16 FORMAT(15H NEUTRON ENERGYE15.6)                                   RMP1136
   14 FORMAT(53H CROSS-SECTIONS CALCULATED WITHOUT DOPPLER BROADENING)  RMP1137
   15 FORMAT(50H CROSS-SECTIONS CALCULATED WITH DOPPLER BROADENING)     RMP1138
   17 FORMAT(33H (Z,A) DESIGNATION OF THE ELEMENTE11.4,22H AT.WT/MASS OFRMP1139
     1 NEUTRONE11.4,15H NO OF ISOTOPESI5)                               RMP1140
   18 FORMAT(24H DATA FOR ISOTOPE NUMBERI5)                             RMP1141
   19 FORMAT(33H (Z,A) DESIGNATION OF THE ISOTOPEE11.4,21H FRACTIONAL ABRMP1142
     1UNDANCEE11.4,20H NO OF ENERGY RANGESI5)                           RMP1143
   20 FORMAT(36H LOWER LIMIT OF THE ENERGY RANGE(EV)E11.4,18H   UPPER LIRMP1144
     1MIT(EV)E11.4,6H  LRU=I5,6H  LRF=I5)                               RMP1145
   21 FORMAT(13H NUCLEAR SPINE11.4,18H SCATTERING LENGTHE11.4,15H NO OF RMP1146
     1L-VALUESI5)                                                       RMP1147
   22 FORMAT(45H MASS OF THE ISOTOPE IN UNITS OF NEUTRON MASSE11.4,22H SRMP1148
     1CATTERING LENGTH(A=)E11.4,17H ANGULAR MOMENTUMI5,17H NO OF RESONANRMP1149
     2CESI5)                                                            RMP1150
   23 FORMAT(84H      ERES           SPIN           GN           GGAMMARMP1151
     1          GFA           GFB)                                      RMP1152
   24 FORMAT(11H TITLE     7A4)                                         RMP1153
   25 FORMAT(//)                                                        RMP1154
   26 FORMAT(6(2X,E11.4,2X))                                            RMP1155
   27 FORMAT(33H CROSS-SECTIONS AT THERMAL ENERGY)                      RMP1156
   28 FORMAT(2X,2E20.6,I10)                                             RMP1157
   29 FORMAT(2X,4E11.4)                                                 RMP1158
   30 FORMAT(22H EFFECTIVE TEMPERATUREF5.1,41H  IN DEGREES KELVIN,   NO RMP1159
     1OF PIVOT POINTSI5,18H CONVERGENCE ERRORE10.4,13H AND INCROSS=I5)  RMP1160
   31 FORMAT(54H THE INTEGRAL FOR DOPPLER BROADENING DOES NOT CONVERGE) RMP1161
   33 FORMAT(126H1 PROGRAM    RAMP1,    PROGRAM TO CALCULATE CROSS-SECTIRMP1162
     1ONS ACCORDING TO THE REICH-MOORE FORMALISM, USES ENDF/B VERSION IIRMP1163
     2 DATA)                                                            RMP1164
C-----THIS IS WHERE RESONANCES OF EACH ISOTOPE ARE ARRANGED IN INCREASINRMP1165
C-----G ORDER IN L AND FOR EACH L IN INCREASING ORDER IN J.             RMP1166
      DO 133 I=1,NIS                                                    RMP1167
      NRESI=NRES(I)                                                     RMP1168
      CALL ORDER(I,NRESI)                                               RMP1169
  133 CONTINUE                                                          RMP1170
   13 FORMAT(10I10)                                                     RMP1171
      NCOUNT=1                                                          RMP1172
      DO 1330 I=1,NIS                                                   RMP1173
      XWR=AWRI(I)                                                       RMP1174
      YWR=XWR*1.008665                                                  RMP1175
      YWR=YWR**(1.0/3.0)                                                RMP1176
      APX=0.123*YWR+0.08                                                RMP1177
      NRESI=NRES(I)                                                     RMP1178
      NLMT=NCOUNT+NRESI-1                                               RMP1179
      DO 1331 J=NCOUNT,NLMT                                             RMP1180
      CALL FACTS(ARAY(1,J),IRAY(1,J),PENFAR(J),SHIFAR(J),PS,CONST,XWR,  RMP1181
     1APX,1.0)                                                          RMP1182
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 1331 CONTINUE                                                          RMP1183
      NCOUNT=NCOUNT+NRESI                                               RMP1184
 1330 CONTINUE                                                          RMP1185
      DO 108 I=1,NTOTAL                                                 RMP1186
      ERAN(1,I)=ARAY(1,I)                                               RMP1187
      ABGFA=ABS(ARAY(5,I))                                              RMP1188
      ABGFB=ABS(ARAY(6,I))                                              RMP1189
      ERAN(2,I)=ARAY(3,I)+ARAY(4,I)+ABGFA+ABGFB                         RMP1190
  108 CONTINUE                                                          RMP1191
      CALL QIKS(1,NTOTAL,MOV,KOM)                                       RMP1192
C-----HERE RESONANCE IN AN ELEMENT ARE ARRANGED IN INCREASING ORDER IN  RMP1193
C-----ENERGY ALONG WITH THEIR TOTAL GAMMAS TO CALCULATE THE ENERGY MESH RMP1194
C-----AT WHICH THE CROSS-SECTIONS ARE CALCULATED.                       RMP1195
  146 PRINT27                                                           RMP1196
      PRINT25                                                           RMP1197
      PRINT7                                                            RMP1198
      E=ETHERM                                                          RMP1199
      CALL RMSIGM(ETHERM,1)                                             RMP1200
      PRINT25                                                           RMP1201
      ELO=EL(1,1)                                                       RMP1202
      JFLAG(1)=1                                                        RMP1203
      IRANGE=1                                                          RMP1204
      PRINT8,ETHERM,(AREF(LL),LL=1,4)                                   RMP1205
  148 PRINT25                                                           RMP1206
      PRINT7                                                            RMP1207
      PRINT25                                                           RMP1208
      DO 124 JJ=1,NIS                                                   RMP1209
      NERJJ=NER(JJ)                                                     RMP1210
      DO 125 KK=1,NERJJ                                                 RMP1211
      IRANGE=KK                                                         RMP1212
      LRUJK=LRU(JJ,KK)                                                  RMP1213
      IF(LRUJK-1)131,1321,125                                           RMP1214
  131 PRINT10                                                           RMP1215
      GO TO 130                                                         RMP1216
 1321 IF(JJ.EQ.1)GO TO 1320                                             RMP1217
      GO TO 132                                                         RMP1218
 1320 ELOREF=EL(JJ,KK)                                                  RMP1219
      EHIREF=EH(JJ,KK)                                                  RMP1220
      ELO=ELOREF                                                        RMP1221
      EHI=EHIREF                                                        RMP1222
      GO TO 1240                                                        RMP1223
  132 ELO=EL(JJ,KK)                                                     RMP1224
      EHI=EH(JJ,KK)                                                     RMP1225
      IF(ELO.EQ.ELOREF.AND.EHI.EQ.EHIREF)GO TO 124                      RMP1226
      GO TO 1240                                                        RMP1227
 1240 MM=MAXPTS/(8*MAXRES)                                              RMP1228
      NN=MM                                                             RMP1229
      IFLAG=1                                                           RMP1230
      NLSKK=NLS(JJ,KK)                                                  RMP1231
      J4=1                                                              RMP1232
      ISTART=1                                                          RMP1233
      IEND=1                                                            RMP1234
  117 IF(IEND-EQ.0)GO TO 125                                            RMP1235
      J5=J4+1                                                           RMP1236
      E1=ERAN(1,J4)                                                     RMP1237
      G1=ERAN(2,J4)                                                     RMP1238
      E2=ERAN(1,J5)                                                     RMP1239
      G2=ERAN(2,J5)                                                     RMP1240
      IF(E1.LT.ELO.AND.E2.LT.ELO)GO TO 1120                             RMP1241
 1105 IF(E1.LE.ELO.AND.E2.GT.ELO)GO TO 1110                             RMP1242
      GO TO 1111                                                        RMP1243
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 1110 E1=ELO                                                              RMP1244
      G1=G2                                                               RMP1245
      ISTART=0                                                            RMP1246
      GO TO 1114                                                          RMP1247
 1111 IF(E1.GT.ELO.AND.E2.LE.EHI)GO TO 1112                               RMP1248
      GO TO 1113                                                          RMP1249
 1112 IF(J4.EQ.1.AND.ISTART.EQ.1)GO TO 1106                               RMP1250
      GO TO 1114                                                          RMP1251
 1106 E2=E1                                                               RMP1252
      G2=G1                                                               RMP1253
      E1=ELO                                                              RMP1254
      J4=J4-1                                                             RMP1255
      ISTART=0                                                            RMP1256
      GO TO 1114                                                          RMP1257
 1116 E2=EHI+G1/FLOAT (MM)                                                RMP1258
      G2=G1                                                               RMP1259
      IFLAG=0                                                             RMP1260
      GO TO 1114                                                          RMP1261
 1113 IF(E1.LT.EHI.AND.E2.GE.EHI)GO TO 1123                               RMP1262
      GO TO 1124                                                          RMP1263
 1123 E2=EHI                                                              RMP1264
      G2=G1                                                               RMP1265
      IEND=0                                                              RMP1266
      GO TO 1114                                                          RMP1267
 1124 IF(E1.GE.EHI.AND.E2.GT.EHI)GO TO 125                                RMP1268
      GO TO 1125                                                          RMP1269
 1125 IF(IFLAG)1120,125,1120                                              RMP1270
 1114 IF(E1.EQ.E2)GO TO 1120                                              RMP1271
      GO TO 1118                                                          RMP1272
 1118 CONTINUE                                                            RMP1273
      CALL SIEVE(E1,G1,E2,G2,MM,NN,NX,TEFF,AWR)                           RMP1274
      CALL QIKS(1,NX,MOVE,KOME)                                           RMP1275
      GO TO 116                                                           RMP1276
 1120 IF(IEND.EQ.0)GO TO 125                                              RMP1277
      J4=J4+1                                                             RMP1278
      GO TO 117                                                           RMP1279
  116 DO 109 I=1,NX                                                       RMP1280
      E=EX(I)                                                             RMP1281
      JFLAGI=JFLAG(I)                                                     RMP1282
      CALL RMSIGM(E,KK)                                                   RMP1283
      PRINT8,E,(AREF(LL),LL=1,4)                                          RMP1284
      IF(IDPL.EQ.1)GO TO 141                                              RMP1285
      GO TO 109                                                           RMP1286
  141 IF(E.LT.ETHERM)GO TO 109                                            RMP1287
      GO TO 1410                                                          RMP1288
C-----IF THE NEUTRON ENERGY IS LESS THAN 0.0253 EV DOPPLER BROADENING ISRMP1289
C---=-PASSED AS A DIFFERENT KERNEL SHOULD BE USED TO CALCULATE DOPPLER   RMP1290
C---=-BROADENED CROSS-SECTIONS.                                          RMP1291
 1410 TEF=TEFF/293.0                                                     RMP1292
      DELTA=0.3177*SQRT ((TEF*E)/AWR)                                     RMP1293
      GO TO (1121,1122),JFLAGI                                            RMP1294
 1121 CALL GRID(E,DELTA,NTAB,XTAB)                                        RMP1295
   32 FORMAT(2X,11E11.4)                                                  RMP1296
      CALL GREAT2(DOPPLER,FINT,XTAB,NTAB,ERROR,IERR)                      RMP1297
      PRINT28,E,FINT,JFLAG(I)                                             RMP1298
      IF(IERR.EQ.1)PRINT31                                                RMP1299
      GO TO 109                                                           RMP1300
 1122 CALL GAUSS(E,DELTA,DOPE)                                            RMP1301
      PRINT28,E,DOPE,JFLAG(I)                                             RMP1302
  109 CONTINUE                                                            RMP1303
      IF(IFLAG)1117,125,1117                                              RMP1304
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 1117 J4=J4+1                                                          RMP1305
      IF(NTOTAL-J4)125,1250,117                                        RMP1306
 1250 E1=ERAN(1,J4)                                                    RMP1307
      G1=ERAN(2,J4)                                                    RMP1308
      GO TO 1116                                                       RMP1309
  125 CONTINUE                                                         RMP1310
  124 CONTINUE                                                         RMP1311
  120 CONTINUE                                                         RMP1312
  130 CALL EXIT                                                        RMP1313
      END                                                              RMP1314
      SUBROUTINE QIKS (MM,NN,MOVE,COMPAR)                              QIKS0010
CQIKS          ALL-IN-MEMORY SORT PROGRAM                             QIKS0020
C     MM = FIRST SUBSCRIPT                                            QIKS0030
C     NN = LAST SUBSCRIPT  (ARRAY IS IN COMMON)                       QIKS0040
C     MOVE AND COMPAR ARE USER SUPPLIED PROGRAMS                      QIKS0050
      DIMENSION MSAVE(20),NSAVE(20)                                    QIKS0060
      KEYLOC(M,N)=(N+M)/2                                              QIKS0070
      I=0                                                              QIKS0080
      J=0                                                              QIKS0090
      LEVEL  = 0                                                       QIKS0100
      M=MM                                                             QIKS0110
      N=NN                                                             QIKS0120
   35 CONTINUE                                                         QIKS0130
C     TEST FOR ONE OR TWO ITEMS                                       QIKS0140
      IF(N-M-1) 31,51,32                                               QIKS0150
C  32 CONTINUE                                                        QIKS0160
C     PARTITION AND SPREADER GO HERE, SEE BELOW,  RETURN IS TO 8      QIKS0170
C     PUSH DOWN                                                       QIKS0180
    8 LEVEL=LEVEL+1                                                    QIKS0190
C     WORK ON SMALLEST PORTION                                        QIKS0200
      IF ((J-M) - (N-I)) 134, 134, 34                                  QIKS0210
  134 MSAVE(LEVEL) = I                                                 QIKS0220
      NSAVE(LEVEL)=N                                                   QIKS0230
      N=J                                                              QIKS0240
      GO TO 35                                                         QIKS0250
   34 MSAVE(LEVEL)=M                                                   QIKS0260
      NSAVE(LEVEL)=J                                                   QIKS0270
      M=I                                                              QIKS0280
      GO TO 35                                                         QIKS0290
   51 IF(COMPAR(M,N))31,31,131                                         QIKS0300
C     SWAP IF ONLY TWO ITEMS ARE OUT OF ORDER                         QIKS0310
  131 CALL MOVE(M,0)                                                   QIKS0320
      CALL MOVE(N,M)                                                   QIKS0330
      CALL MOVE(0,N)                                                   QIKS0340
   31 IF (LEVEL) 151, 150, 151                                         QIKS0350
  150 RETURN                                                           QIKS0360
C     POP UP                                                          QIKS0370
  151 M = MSAVE(LEVEL)                                                 QIKS0380
      N=NSAVE(LEVEL)                                                   QIKS0390
      LEVEL=LEVEL-1                                                    QIKS0400
      GO TO 35                                                         QIKS0410
C     END   MAIN                                                      QIKS0420
C     PARTITION                                                       QIKS0430
   32 I=M                                                              QIKS0440
      J=N                                                              QIKS0450
      KEY=KEYLOC(M,N)                                                  QIKS0460
      CALL MOVE(KEY, 0)                                                QIKS0470
   54 IF (N - KEY) 17, 1, 17                                           QIKS0480
   17 CALL MOVE(N,KEY)                                                 QIKS0490
    1 CONTINUE                                                         QIKS0500
C     HOLE AT BOTTOM                                                  QIKS0510
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      IF(COMPAR(0,I))3,2,2                                          QIKS0520
    2 I=I+1                                                         QIKS0530
      IF (I - J) 1, 4, 1                                            QIKS0540
    3 CALL MOVE(I,J)                                                QIKS0550
      GO TO 5                                                       QIKS0560
    6 CONTINUE                                                      QIKS0570
C     HOLE AT TOP                                                   QIKS0580
      IF(COMPAR(0,J))5,5,7                                          QIKS0590
    5 J=J-1                                                         QIKS0600
      IF (I - J) 6, 4, 6                                            QIKS0610
    7 CALL MOVE(J,I)                                                QIKS0620
      GO TO 2                                                       QIKS0630
C   4 CONTINUE                                                      QIKS0640
C     SPREADER GOES HERE                                            QIKS0650
C     END   PARTITION                                               QIKS0660
C     SPREADER                                                      QIKS0670
    4 CALL MOVE(0,I)                                                QIKS0680
   12 IF (I - N) 110, 10, 110                                       QIKS0690
  110 I = I + 1                                                     QIKS0700
      IF(COMPAR(0,I))10,12,10                                       QIKS0710
   10 IF (J - M) 108, 8, 108                                        QIKS0720
  108 J = J - 1                                                     QIKS0730
      IF(COMPAR(0,J))8,10,8                                         QIKS0740
C   8 CONTINUE                                                      QIKS0750
C     RETURN TO MAIN PROGRAM                                        QIKS0760
      END                                                           QIKS0770
      SUBROUTINE MOV(I,J)                                           MOV 001
      COMMON/D/ERAN(2,501)                                          MOV 002
      I1=I                                                          MOV 003
      J1=J                                                          MOV 004
      IF(I1.EQ.0)I1=501                                             MOV 005
      IF(J1.EQ.0)J1=501                                             MOV 006
      ERAN(1,J1)=ERAN(1,I1)                                         MOV 007
      ERAN(2,J1)=ERAN(2,I1)                                         MOV 008
      RETURN                                                        MOV 009
      END                                                           MOV 010
      SUBROUTINE MOVE(I,J)                                          MOVE001
      COMMON/C/EX(101),JFLAG(101)                                   MOVE002
      I1=I                                                          MOVE003
      J1=J                                                          MOVE004
      IF(I1.EQ.0)I1=101                                             MOVE005
      IF(J1.EQ.0)J1=101                                             MOVE006
      EX(J1)=EX(I1)                                                 MOVE007
      JFLAG(J1)=JFLAG(I1)                                           MOVE008
      RETURN                                                        MOVE009
      END                                                           MOVE010
      FUNCTION KOM(I,J)                                             KOM 001
      COMMON/D/ERAN(2,501)                                          KOM 002
      I1=I                                                          KOM 003
      J1=J                                                          KOM 004
      IF(I1.EQ.0)I1=501                                             KOM 005
      IF(J1.EQ.0)J1=501                                             KOM 006
      EOM=ERAN(1,I1)-ERAN(1,J1)                                     KOM 007
      IF(EOM)100,101,102                                            KOM 008
  100 KOM=-1                                                        KOM 009
      GO TO 103                                                     KOM 010
  101 KOM=0                                                         KOM 011
      GO TO 103                                                     KOM 012
  102 KOM=1                                                         KOM 013
  103 RETURN                                                        KOM 014
      END                                                           KOM 015
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      FUNCTION KOME(I,J)                                                KOME001
      COMMON/C/EX(101),JFLAG(101)                                       KOME002
      I1=I                                                              KOME003
      J1=J                                                              KOME004
      IF(I1.EQ.0)I1=101                                                 KOME005
      IF(J1.EQ.0)J1=101                                                 KOME006
      EOX=EX(I1)-EX(J1)                                                 KOME007
      IF(EOX)100,101,102                                                KOME008
  100 KOME=-1                                                           KOME009
      GO TO 103                                                         KOME010
  101 KOME=0                                                            KOME011
      GO TO 103                                                         KOME012
  102 KOME=1                                                            KOME013
  103 RETURN                                                            KOME014
      END                                                               KOME015
      SUBROUTINE GREAT2(F,FINT,XTAB,NTAB,ERROR,IERR)                    GRT2001
C-----CARRY OUT CONVERGENCE INTEGRATION SCHEME USING UP TO 200 INTERVALSGRT2002
C-----WHICH ARE THEN FURTHER SUBDIVIDED UNTIL CONVERGENCE OCCURS OR THE GRT2003
C----MAXIMUM ALLOWABLE NUMBER OF ITERATIONS IS EXCEEDED, THE SUBROUTINEGRT2004
C----ARGUMENTS ARE DEFINED AS FOLLOWS.......                            GRT2005
C-----F      =FUNCTION TO BE INTEGRATED.                                GRT2006
C-----FINT   =THE RESULTING INTEGRAL                                    GRT2007
C-----XTAB   =TABLE OF ORDINATES (INTEGRATION INTERVAL IS FROM XTAB(1) TOGRT2008
C-----        XTAB(NTAB))                                               GRT2009
C-----NTAB   =THE LENGTH OF THE XTAB TABLE (NUMBER OF ORDINATES).       GRT2010
C-----ERROR  =ALLOWABLE NORMAL ERROR.                                   GRT2011
C-----IERR   =ERROR INDICATOR SET TO ZERO IF METHOD CONVERGES, SET TO   GRT2012
C-----        ONE IF METHOD DOES NOT CONVERGE.                          GRT2013
C-----        ONE IF METHOD DOES NOT CONVERGE OR TABLE (XTAB) IS TOO LONGGRT2014
      DIMENSION XTAB(33),PARTS(33),GOOF(33),INTER(33)                   GRT2015
C-----DEFINE THE MAXIMUM ALLOWABLE NUMBER OF ITERATIONS AND THE MAXIMUM GRT2016
C-----TABLE LENGTH.                                                     GRT2017
      DATA JMAX,NTABMX/20,1000/                                         GRT2018
C-----DETERMINE IF TABLE IS TOO LONG                                    GRT2019
      IF(NTAB.GT.NTABMX) GO TO 100                                      GRT2020
C-----CALL GENERAL INTEGRATION SUBROUTINE.                              GRT2021
      ZZZ=F(5.0)                                                        GRT20211
      CALL GREAT1(F,FINT,NTAB,JMAX,XTAB,PARTS,GOOF,INTER,ERROR,IERR)    GRT2022
      RETURN                                                            GRT2023
C-----TABLE IS TOO LONG.                                                GRT2024
  100 IERR=1                                                            GRT2025
      FINT=0.0                                                          GRT2026
      RETURN                                                            GRT2027
      END                                                               GRT2028
      SUBROUTINE GREAT1(F,FINT,NTAB,JMAX,XTAB,PARTS,GOOF,INTER,ERROR,   GRT1001
     1 IERR)                                                            GRT1002
C-----CARRY OUT CONVERGENCE INTEGRATION SCHEME USING TRAPAZOIDAL RULE   GRT1003
C----AND DOUBLING THE NUMBER OF REGIONS PER SUBINTERVAL FOR EACH        GRT1004
C----ITERATION, ONLY DOUBLE UP IN THOSE INTERVALS THAT HAVE NOT ALREADYGRT1005
C---CONVERGED.                                                          GRT1006
C----F      =SINGLE PRECISION FUNCTION TO BE INTEGRATED                 GRT1007
C---FINT   =THE RESULTING INTEGRAL                                      GRT1008
C----NTAB   =NUMBER OF ORDINATES SUPPLIED (THERE ARE N-1 INTERVALS)     GRT1009
C---JMAX   =MAXIMUM ALLOWABLE NUMBER OF ITERATIONS                      GRT1010
C----XTAB   =TABLE OF THE ORDINATE VALUES, RANGE OF INTEGRATION IS      GRT1011
C---         FROM XTAB(1) TO XTAB(NTAB)                                 GRT1012
C-----PARTS =ARRAY OF DIMENSION NTAB, EQUAL TO THE PARTIAL INTEGRALS    GRT1013
C---         OVER EACH OF THE NTAB-1 INTERVALS                          GRT1014
C----GOOF   =ARRAY OF DIMENSION NTAB, EQUAL TO THE NORMAL ERROR IN EACH GRT1015
C---         OF THE NTAB-1 INTERVAL.                                    GRT1016
C---INTER  =ARRAY OF DIMENSION NTAB, SEPECIFYING THE NUMBER OF          GRT1017
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C---==        SUBINTERVALS IN EACH INTERVAL                                    GRT1018
C-----ERROR =ACCEPTABLE NORMAL ERROR                                           GRT1019
C---==IERR  =ERROR INDICATOR, SET TO ZERO IF METHOD CONVERGES, SET TO           GRT1020
C---==        ONE IF METHOD DOES NOT CONVERGE                                  GRT1021
      DIMENSION XTAB(NTAB),PARTS(NTAB),INTER(NTAB),GOOF(NTAB)                  GRT1022
C---==INITIALIZE VALUE OF THE INTEGRAL                                         GRT1023
      FINT=0.0                                                                 GRT1024
C---==CALCULATE THE NUMBER OF INTERVALS                                        GRT1025
      NM1=NTAB-1                                                               GRT1026
C-----CALCULATE ALLOWABLE ERROR PER INTERVAL                                   GRT1027
      ERRN=ERROR/FLOAT(NM1)                                                    GRT1028
C----=INITIALIZE APPROXIMATION TO INTEGRAL                                     GRT1029
      TOTAL=0.0                                                                GRT1030
C-----CALCULATE INITIAL APPROXIMATION                                          GRT1031
      DO 10 I=1,NM1                                                            GRT1032
      INTER(I)=1                                                               GRT1033
      PARTS(I)=0.5*(XTAB(I+1)-XTAB(I))*(F(XTAB(I+1))+F(XTAB(I)))               GRT1034
   10 TOTAL=TOTAL+PARTS(I)                                                     GRT1035
C----=CALCULATE INITIAL ERRORS                                                 GRT1036
      DO 15 I=1,NM1                                                            GRT1037
   15 GOOF(I)=PARTS(I)                                                         GRT1038
C-----SET UP LOOP OVER ITERATIONS                                              GRT1039
      DO 100 J=1,JMAX                                                          GRT1040
C----=SAVE LAST APPROXIMATION                                                  GRT1041
      TOTAL1=TOTAL                                                             GRT1042
C----=SET UP LOOP OVER INTERVALS                                               GRT1043
      DO 20 I=1,NM1                                                            GRT1044
C-----CHECK FOR CONVERGENCE IN THIS INTERVAL                                   GRT1045
      IF(ABS(GOOF(I)/TOTAL),LT,ERRN) GO TO 20                                  GRT1046
C----=CALCULATE DOUBLE INTERVAL                                                GRT1047
      DX=(XTAB(I+1)-XTAB(I))/FLOAT(INTER(I))                                   GRT1048
C-----DOUBLE NUMBER OF STEPS                                                   GRT1049
      INTER(I)=2*INTER(I)                                                      GRT1050
C----=INITIALIZE CONTRIBUTION TO INTEGRAL                                      GRT1051
      REST=0.0                                                                 GRT1052
      II=INTER(I)                                                              GRT1053
C----=INITIALIZE ORDINATE                                                      GRT1054
      XNOW=XTAB(I)+0.5*DX                                                      GRT1055
C-----SET UP LOOP OVER ORDINATES                                               GRT1056
      DO 30 K=1,II,2                                                           GRT1057
      REST=REST+F(XNOW)                                                        GRT1058
   30 XNOW=XNOW+DX                                                             GRT1059
C-----CALCULATE NEXT PARTIAL INTEGRAL                                          GRT1060
      REST=0.5*(PARTS(I)+DX*REST)                                              GRT1061
C---==ADD NEW PARTIAL INTEGRAL AND SUBTRACT OLD PARTIAL INTEGRAL                GRT1062
      TOTAL=TOTAL+REST-PARTS(I)                                                GRT1063
C----=CALCULATE NEW ERROR AND SET PARTIAL INTEGRAL TO NEW VALUE                GRT1064
      GOOF(I)=REST-PARTS(I)                                                    GRT1065
      PARTS(I)=REST                                                            GRT1066
   20 CONTINUE                                                                 GRT1067
C----=CHECK FOR CONVERGENCE                                                    GRT1068
  100 IF(ABS(1.-TOTAL1/TOTAL),LE,ERROR) GO TO 200                              GRT1069
C-----THE METHOD HAS NOT CONVERGED                                             GRT1070
      FINT=TOTAL                                                               GRT1071
      IERR=1                                                                   GRT1072
      RETURN                                                                   GRT1073
C----=THE METHOD HAS CONVERGED                                                 GRT1074
  200 FINT=TOTAL                                                               GRT1075
      IERR=0                                                                   GRT1076
      RETURN                                                                   GRT1077
      END                                                                      GRT1078
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      SUBROUTINE GRID(Q,BELTA,NTAB,XTAB)                                GRID001
      COMMON ARAY,IRAY,ERAY,NOT,ZAI,ABN,NER,LFW,EL,EH,LRU,LRF,LANG,NLS, GRID002
     1NRES,LN,JN,PENFAR,SHIFAR,SPI,AP,AWRI,AM,DREF,AREF,BREF,IRANGE,NIS,GRID003
     3INCROSS,IVSPIN,ELO,TEFF,DELTA,E,AWR                               GRID004
      DIMENSION ARAY(6,500),IRAY(3,500),ERAY(2,500),NOT(20),ZAI(10),    GRID005
     1ABN(10),NER(10),LFW(10),EL(10,10),EH(10,10),LRU(10,10),LRF(10,10),GRID006
     2LANG(10,5,5),NLS(10,10),NRES(10),LN(50),JN(150),PENFAR(500),      GRID007
     3SHIFAR(500),SPI(10),AP(10),AWRI(10),AM(10),DREF(6),AREF(6),BREF(6,GRID008
     410)                                                               GRID009
      DIMENSION XTAB(33)                                                GRID010
      IGNORE=1                                                          GRID011
      N2=NTAB/2                                                         GRID012
      N21=N2+1                                                          GRID013
      N22=N2+2                                                          GRID014
      N3=NTAB-1                                                         GRID015
      XTAB(N21)=Q                                                       GRID016
      DO 1410 I=N22,NTAB                                                GRID017
      XTAB(I)=XTAB(I-1)+BELTA                                           GRID018
      II=NTAB+1-I                                                       GRID019
      XTAB(II)=XTAB(II+1)-BELTA                                         GRID020
 1410 CONTINUE                                                          GRID021
      DO 1411 I=1,NTAB                                                  GRID022
      XTABI=XTAB(I)                                                     GRID023
      IF(XTABI)1412,1412,1411                                           GRID024
 1412 IGNORE=0                                                          GRID025
 1411 CONTINUE                                                          GRID026
      IF(IGNORE.EQ.0)GO TO 1413                                         GRID027
      GO TO 1414                                                        GRID0271
 1413 XTAB(1)=1.0E-03                                                   GRID028
      DO 1415 I=1,N3                                                    GRID029
      I1=I+1                                                            GRID030
      XTAB(I1)=XTAB(1)+FLOAT (I)*BELTA                                  GRID031
 1415 CONTINUE                                                          GRID032
 1414 RETURN                                                            GRID033
      END                                                               GRID034
      SUBROUTINE GAUSS(Q,BELTA,DOPE)                                    GAUS001
      COMMON ARAY,IRAY,ERAY,NOT,ZAI,ABN,NER,LFW,EL,EH,LRU,LRF,LANG,NLS, GAUS002
     1NRES,LN,JN,PENFAR,SHIFAR,SPI,AP,AWRI,AM,DREF,AREF,BREF,IRANGE,NIS,GAUS003
     3INCROSS,IVSPIN,ELO,TEFF,DELTA,E,AWR                               GAUS004
      DIMENSION ARAY(6,500),IRAY(3,500),ERAY(2,500),NOT(20),ZAI(10),    GAUS005
     1ABN(10),NER(10),LFW(10),EL(10,10),EH(10,10),LRU(10,10),LRF(10,10),GAUS006
     2LANG(10,5,5),NLS(10,10),NRES(10),LN(50),JN(150),PENFAR(500),      GAUS007
     3SHIFAR(500),SPI(10),AP(10),AWRI(10),AM(10),DREF(6),AREF(6),BREF(6,GAUS008
     410)                                                               GAUS009
      DIMENSION ABC(9),WET(9)                                           GAUS010
      DATA ABC/-3.1909932017815 3,-2.2665805845 5184,-1.4685532892 1667,-0,GAUS011
     1723551018752 84,0.0,0.723551018752 84,1.4685532892 1667,2.2665805845 3GAUS012
     2184,3.1909932017815 3/                                            GAUS013
      DATA WET/0.3960697726326E-04,0.4943624275537E-02,0.8847452739438E-GAUS014
     101,0.4326515570026E+00,0.7202352156061E+00,0.4326515570026E+00,0.8GAUS015
     2847452739438E-01,0.4943624275537E-02,0.3960697726326E-04/         GAUS016
      DATA PHIRT/1.772454/                                              GAUS017
      TEF=TEFF/293.0                                                    GAUS018
      TERM=0.0                                                          GAUS019
      DO 200 K=1,NIS                                                    GAUS020
      T1=0.0                                                            GAUS021
      XWR=AWRI(K)                                                       GAUS022
      BELTA=(0.3177E+00)*SQRT((Q*TEF)/XWR)                              GAUS023
      X=BELTA*ABC(9)                                                    GAUS024
      IF(E-X)100,100,101                                                GAUS025
  101 DO 102 I=1,9                                                      GAUS026
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      ABCI=ABC(I)                                                       GAUS027
      WETI=WET(I)                                                       GAUS028
      Z=E+ABCI*BELTA                                                    GAUS029
      CALL RMSIGM(Z,IRANGE)                                             GAUS030
      T1=T1+BREF(INCROSS,K)*WETI                                        GAUS031
  102 CONTINUE                                                          GAUS032
      GO TO 110                                                         GAUS033
  100 T1=0.0                                                            GAUS034
  110 TERM=TERM+T1                                                      GAUS035
  200 CONTINUE                                                          GAUS036
      DOPE=TERM/PHIRT                                                   GAUS037
      RETURN                                                            GAUS038
      END                                                               GAUS039
      SUBROUTINE FACTS(Q,L,PF,SF,PS,CONSTE,BWR,BP,PLOD)                 FACT001
C                                                                       FACT002
C     SUBROUTINE TO CALCULATE PENETRATION AND                           FACT003
C                SHIFT FACTORS                                          FACT004
C     Q IS THE ENERGY L IS THE ANGULAR MOMENTUM PF PENETRATION FACTOR   FACT005
C     SF THE SHIFT FACTOR AND PS THE PHASE SHIFT AP IS R CONSTE IS KM   FACT006
C     FOR DETAILS OF FORMULAE SEE GREGSON ET AL AEEW-M517(MLBW)1965     FACT007
C                                                                       FACT008
      DOUBLE PRECISION  PS,CONSTE,ROE,ROE2,ROE4                         FACT009
      EAB=ABS(Q)                                                        FACT010
      CONHLD=2.196771E-03*BWR*SQRT(EAB)                                 FACT011
      CONSTE=CONHLD/(BWR+1.0)                                           FACT012
C-----SINCE AWR IS GIVEN WITH THE NEUTRON MASS AS UNITY WE ADD ONE ABOVEFACT013
C---  TO CONVERT TO THE CENTER-OF-MASS SYSTEM                           FACT014
      ROE=BP*CONSTE                                                     FACT015
      S=FLOAT (L)                                                       FACT016
      IF(L.LE.0)GO TO 100                                               FACT017
      GO TO(110,120,130,140,150),L                                      FACT018
  100 PF=ROE                                                            FACT019
      SF=0.0                                                            FACT020
      IF(PLOD.LT.2.0) GO TO 160                                         FACT021
      PS=ROE                                                            FACT022
      GO TO 170                                                         FACT023
  110 ROE2=ROE*ROE                                                      FACT024
      DENOM=1.0+ROE2                                                    FACT025
      PF=ROE2*ROE/DENOM                                                 FACT026
      SF=-1.0/DENOM                                                     FACT027
      IF(PLOD.LT.2.0) GO TO 160                                         FACT028
      PS=ROE-DATAN(ROE)                                                 FACT029
      IF(PS/ROE-0.000001)160,170,170                                    FACT030
  120 ROE2=ROE*ROE                                                      FACT031
      ROE4=ROE2*ROE2                                                    FACT032
      DENOM=3.0*ROE2+ROE4+9.0                                           FACT033
      PF=ROE4*ROE/DENOM                                                 FACT034
      SF=-(18.0+3.0*ROE2)/DENOM                                         FACT035
      IF(PLOD.LT.2.0) GO TO 160                                         FACT036
      PS=ROE-DATAN(3.0*ROE/(3.0-ROE2))                                  FACT037
      IF(PS/ROE-0.000001)160,170,170                                    FACT038
  130 ROE2=ROE*ROE                                                      FACT039
      ROE4=ROE2*ROE2                                                    FACT040
      ROE6=ROE4*ROE2                                                    FACT041
      DENOM=225.0+45.0*ROE2+6.0*ROE4+ROE6                               FACT042
      PF=ROE6*ROE/DENOM                                                 FACT043
      SF=-(675.0+90.0*ROE2+6.0*ROE4)/DENOM                              FACT044
      IF(PLOD.LT.2.0) GO TO 160                                         FACT045
      PS=ROE-DATAN((15.0*ROE-ROE2*ROE)/(15.0-6.0*ROE2))                 FACT046
      IF(PS/ROE-0.000001)160,170,170                                    FACT047
  140 ROE2=ROE*ROE                                                      FACT048
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      ROE4=ROE2*ROE2                                                    FACT049
      ROE6=ROE4*ROE2                                                    FACT050
      ROE8=ROE4*ROE4                                                    FACT051
      DENOM=11025.0+1575.0*ROE2+135.0*ROE4+10.0*ROE6+ROE8               FACT052
      PF=ROE8*ROE/DENOM                                                 FACT053
      IF(PLOD.LT.2.0) GO TO 160                                         FACT054
      SF=-(44100.0+4725.0*ROE2+270.0*ROE4+10.0*ROE6)/DENOM              FACT055
      PS=ROE-DATAN((105.0*ROE-10.0*ROE2*ROE)/(105.0-45.0                FACT056
     1*ROE2+ROE4))                                                      FACT057
      IF(PS/ROE-0.000001)160,170,170                                    FACT058
  150 ROE2=ROE*ROE                                                      FACT059
      ROE4=ROE2*ROE2                                                    FACT060
      ROE6=ROE4*ROE2                                                    FACT061
      ROE8=ROE4*ROE4                                                    FACT062
      ROE10=ROE6*ROE4                                                   FACT063
      DENOM=893025.0+99225.0*ROE2+6300.0*ROE4+315.0*ROE6                FACT064
     1+15.0*ROE8+ROE10                                                  FACT065
      PF=ROE10*ROE/DENOM                                                FACT066
      SF=4465125.0+396900.0*ROE2+18900.0*ROE4                           FACT067
     1+630.0*ROE6+15.0*ROE8                                             FACT068
      SF=-SF/DENOM                                                      FACT069
      IF(PLOD.LT.2.0) GO TO 160                                         FACT070
      PS=ROE-DATAN((945.0*ROE-ROE*(105.0*ROE2-ROE4))/(945.0-420.0*ROE2+ FACT071
     1115.0*ROE4))                                                      FACT072
      IF(PS/ROE.GE.0.000001) GO TO 170                                  FACT073
  160 PS=0.0                                                            FACT074
  170 RETURN                                                            FACT075
      END                                                               FACT076
      SUBROUTINE ORDER(K,N1)                                            ORDR001
      COMMON ARAY,IRAY,ERAY,NOT,ZAI,ABN,NER,LFW,EL,EH,LRU,LRF,LANG,NLS, ORDR002
     1NRES,LN,JN,PENFAR,SHIFAR,SPI,AP,AWRI,AM,DREF,AREF,BREF,IRANGE,NIS,ORDR003
     3INCROSS,IVSPIN,ELO,TEFF,DELTA,E,AWR                               ORDR004
      DIMENSION ARAY(6,500),IRAY(3,500),ERAY(2,500),NOT(20),ZAI(10),    ORDR005
     1ABN(10),NER(10),LFW(10),EL(10,10),EH(10,10),LRU(10,10),LRF(10,10),ORDR006
     2LANG(10,5,5),NLS(10,10),NRES(10),LN(50),JN(150),PENFAR(500),      ORDR007
     3SHIFAR(500),SPI(10),AP(10),AWRI(10),AM(10),DREF(6),AREF(6),BREF(6,ORDR008
     410)                                                               ORDR009
      IF(K-1)2,2,3                                                      ORDR010
    2 NTR=0                                                             ORDR011
      NUML=0                                                            ORDR012
      NUMJ=0                                                            ORDR013
      NN=0                                                              ORDR014
      MM=0                                                              ORDR015
      JJ=0                                                              ORDR016
      NC=0                                                              ORDR017
      MC=0                                                              ORDR018
    3 NT=NTR+1                                                          ORDR019
      NTR=NTR+N1                                                        ORDR020
      OL=-0.9                                                           ORDR021
    8 OL=OL+1.0                                                         ORDR022
      DO 101 N=NT,NTR                                                   ORDR023
      TERM=FLOAT (IRAY(1,N))                                            ORDR024
      IF(OL-TERM)101,101,9                                              ORDR025
    9 NN=NN+1                                                           ORDR026
      DO 100J=1,6                                                       ORDR027
      A=ARAY(J,N)                                                       ORDR028
      ARAY(J,N)=ARAY(J,NN)                                              ORDR029
      ARAY(J,NN)=A                                                      ORDR030
  100 CONTINUE                                                          ORDR031
      DO 1001 J=1,3                                                     ORDR032
      IA=IRAY(J,N)                                                      ORDR033
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      IRAY(J,N)=IRAY(J,NN)                                                  ORDR034
      IRAY(J,NN)=IA                                                         ORDR035
 1001 CONTINUE                                                              ORDR036
      DO 1002 J=1,2                                                         ORDR037
      EA=ERAY(J,N)                                                          ORDR038
      ERAY(J,N)=ERAY(J,NN)                                                  ORDR039
      ERAY(J,NN)=EA                                                         ORDR040
 1002 CONTINUE                                                              ORDR041
  101 CONTINUE                                                              ORDR042
      IF(NN-NC)8,8,11                                                       ORDR043
   11 NUML=NUML+1                                                           ORDR044
      LN(NUML)=NN-NC                                                        ORDR045
      NC=NN                                                                 ORDR046
      NU=NT+LN(NUML)-1                                                      ORDR047
      OM= 0.25                                                              ORDR048
   14 OM=OM+0.5                                                             ORDR049
      DO 205 M=NT,NU                                                        ORDR050
      TERMJ=ARAY(2,M)                                                       ORDR051
      IF(OM-TERMJ)205,205,15                                                ORDR052
   15 MM=MM+1                                                               ORDR053
      DO 204 J=1,6                                                          ORDR054
      A=ARAY(J,M)                                                           ORDR055
      ARAY(J,M)=ARAY(J,MM)                                                  ORDR056
      ARAY(J,MM)=A                                                          ORDR057
  204 CONTINUE                                                              ORDR058
      DO 2041 J=1,3                                                         ORDR059
      IA=IRAY(J,M)                                                          ORDR060
      IRAY(J,M)=IRAY(J,MM)                                                  ORDR061
      IRAY(J,MM)=IA                                                         ORDR062
 2041 CONTINUE                                                              ORDR063
      DO 2042 J=1,2                                                         ORDR064
      EA=ERAY(J,M)                                                          ORDR065
      ERAY(J,M)=ERAY(J,MM)                                                  ORDR066
      ERAY(J,MM)=EA                                                         ORDR067
 2042 CONTINUE                                                              ORDR068
  205 CONTINUE                                                              ORDR069
      IF(MM-MC)14,14,16                                                     ORDR070
   16 NUMJ=NUMJ+1                                                           ORDR071
      JN(NUMJ)=MM-MC                                                        ORDR072
      MC=MM                                                                 ORDR073
      NT=NT+JN(NUMJ)                                                        ORDR074
      IF(NN-MM)17,17,14                                                     ORDR075
   17 IF(NTR-NN)18,18,8                                                     ORDR076
   18 RETURN                                                                ORDR077
      END                                                                   ORDR078
      FUNCTION DOPPLER(X)                                                   DOPL001
      COMMON ARAY,IRAY,ERAY,NOT,ZAI,ABN,NER,LFW,EL,EH,LRU,LRF,LANG,NLS,     DOPL002
     1NRES,LN,JN,PENFAR,SHIFAR,SPI,AP,AWRI,AM,DREF,AREF,BREF,IRANGE,NIS,    DOPL003
     3INCROSS,IVSPIN,ELO,TEFF,DELTA,E,AWR                                   DOPL004
      DIMENSION ARAY(6,500),IRAY(3,500),ERAY(2,500),NOT(20),ZAI(10),        DOPL005
     1ABN(10),NER(10),LFW(10),EL(10,10),EH(10,10),LRU(10,10),LRF(10,10),    DOPL006
     2LANG(10,5,5),NLS(10,10),NRES(10),LN(50),JN(150),PENFAR(500),          DOPL007
     3SHIFAR(500),SPI(10),AP(10),AWRI(10),AM(10),DREF(6),AREF(6),BREF(6,    DOPL008
     410)                                                                   DOPL009
      TEF=TEFF/293.0                                                        DOPL010
      TERM=0.0                                                              DOPL011
      CALL RMSIGM(X,IRANGE)                                                 DOPL012
      DO 100 I=1,NIS                                                        DOPL013
      XWR=AWRI(I)                                                           DOPL014
      CELTA=(0.3177E+00)*SQRT((TEF*E)/XWR)                                  DOPL015
      Z=(E-X)/CELTA                                                         DOPL016
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      Z2=Z*Z                                                            DOPL017
      T1=BREF(INCROSS,I)*EXP(-Z2)/(CELTA*1.772454)                      DOPL018
      TERM=TERM+T1                                                      DOPL019
  100 CONTINUE                                                          DOPL020
      DOPPLER=TERM                                                      DOPL021
      RETURN                                                            DOPL022
      END                                                               DOPL023
      SUBROUTINE ABCMAT(A,B,C)                                          ABCM001
      DOUBLE PRECISION A,B,C                                            ABCM002
      DIMENSION A(3,3),B(3,3),C(3,3)                                    ABCM003
      DO 100 I=1,3                                                      ABCM004
      DO 101 J=1,3                                                      ABCM005
      C(I,J)=0.0                                                        ABCM006
      DO 102 K=1,3                                                      ABCM007
      C(I,J)=C(I,J)+A(I,K)*B(K,J)                                       ABCM008
  102 CONTINUE                                                          ABCM009
  101 CONTINUE                                                          ABCM010
  100 CONTINUE                                                          ABCM011
      RETURN                                                            ABCM012
      END                                                               ABCM013
      SUBROUTINE FROBNS(A,B,C,D)                                        FROB001
      DOUBLE PRECISION A,B,C,D,Q                                        FROB002
      DIMENSION A(3,3),B(3,3),C(3,3),D(3,3),Q(3,3)                      FROB003
C-----THIS SUBROUTINE INVERTS A COMPLEX MATRIX WITH REAL AND IMAGINARY  FROB004
C-----PARTS A AND B AND GIVES C AND D THE REAL AND IMAGINARY PARTS OF THFROB005
C-----E INVERSE. FROBENIUS-SCHUR METHOD OF INVERSION.                   FROB006
      DO 200 I=1,3                                                      FROB007
      DO 201 J=1,3                                                      FROB008
      C(I,J)=A(I,J)                                                     FROB009
  201 CONTINUE                                                          FROB010
  200 CONTINUE                                                          FROB011
      CALL THRINV(A,3,IND)                                              FROB012
      IF(IND.EQ.1) GO TO 500                                            FROB013
      CALL ABCMAT(A,B,Q)                                                FROB014
      CALL ABCMAT(B,Q,D)                                                FROB015
      DO 202 I=1,3                                                      FROB016
      DO 203 J=1,3                                                      FROB017
      C(I,J)=C(I,J)+D(I,J)                                              FROB018
  203 CONTINUE                                                          FROB019
  202 CONTINUE                                                          FROB020
      CALL THRINV(C,3,IND)                                              FROB021
      IF(IND.EQ.1) GO TO 500                                            FROB022
      CALL ABCMAT(Q,C,D)                                                FROB023
      DO 204 I=1,3                                                      FROB024
      DO 205 J=1,3                                                      FROB025
      D(I,J)=-D(I,J)                                                    FROB026
  205 CONTINUE                                                          FROB027
  204 CONTINUE                                                          FROB028
      GO TO 502                                                         FROB029
  500 PRINT501                                                          FROB030
      GO TO 502                                                         FROB031
  501 FORMAT(52H TROUBLE IN INVERTING THE COMPLEX MATRIX, JOB ABORT.)   FROB032
  502 RETURN                                                            FROB033
      END                                                               FROB034
      SUBROUTINE THRINV(D,N,KIMERR)                                     THRI001
C INVERTS SYMMETRIC MATRIX (D(I,J),J=1,N,I=1,J)                         THRI002
      DOUBLE PRECISION D,S,FOOEY                                        THRI003
      DIMENSION D(3,3),S(3)                                             THRI004
       KIMERR=0                                                         THRI005
   55 CONTINUE                                                          THRI006
   26 DO1J=1,N                                                          THRI007
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   29 DO2I=1,J                                                          THRI008
      D(I,J)=-D(I,J)                                                    THRI009
    2 D(J,I)=D(I,J)                                                     THRI010
    1 D(J,J)=1.+D(J,J)                                                  THRI011
   30 DO7LR=1,N                                                         THRI012
       FOOEY=1.-D(LR,LR)                                                THRI013
       IF(FOOEY .EQ. 0.0) GO TO 333                                     THRI014
       D(LR,LR) = 1./FOOEY                                              THRI015
   31 CONTINUE                                                          THRI016
       GO TO 27                                                         THRI017
  333 KIMERR=1                                                          THRI018
       GOTO1001                                                         THRI019
   27 DO41J=1,N                                                         THRI020
      S(J)=D(LR,J)                                                      THRI021
   32 IF(J-LR)28,41,28                                                  THRI022
   28 D(J,LR)=D(J,LR)*D(LR,LR)                                          THRI023
      D(LR,J)=D(J,LR)                                                   THRI024
   41 CONTINUE                                                          THRI025
   33 DO 7J=1,N                                                         THRI026
   34 IF(J-LR) 6,7,6                                                    THRI027
    6 DO 503 I=1,J                                                      THRI028
   35 IF(I-LR) 8,503,8                                                  THRI029
    8 D(I,J)=D(I,J)+D(I,LR)*S(J)                                        THRI030
      D(J,I)=D(I,J)                                                     THRI031
  503 CONTINUE                                                          THRI032
    7 CONTINUE                                                          THRI033
 1001 RETURN                                                            THRI034
      END                                                               THRI035
      SUBROUTINE SIEVE(E1,G1,E2,G2,M,N,NX,BEFF,BWR)                     SIEV001
      COMMON/C/EX(101),JFLAG(101)                                       SIEV002
      IF(E2.LT.E1)GO TO 101                                             SIEV003
      GO TO 300                                                         SIEV0031
  300 N2=2*N                                                            SIEV004
      DO 1000I=1,100                                                    SIEV005
      JFLAG(I)=2                                                        SIEV006
 1000 CONTINUE                                                          SIEV007
      TEF=BEFF/293.0                                                    SIEV008
      DP=(1.5885E-00)*SQRT (TEF/BWR)                                    SIEV009
C     WHEN MULTIPLIED BY SQRT(E) DP GIVES 5 TIMES CORRESPONDING DELTA   SIEV010
      DP1=DP*SQRT(E1)                                                   SIEV011
      DP2=DP*SQRT (E2)                                                  SIEV012
      DG1=G1/FLOAT (M)                                                  SIEV013
      DG2=G2/FLOAT (M)                                                  SIEV014
      EX(1)=E1                                                          SIEV015
      IF(G1.LT.DP1)GO TO 1001                                           SIEV016
      GO TO 1002                                                        SIEV0161
 1001 JFLAG(1)=1                                                        SIEV017
 1002 ENDIF=ABS (E2-E1)                                                 SIEV018
      NX=1                                                              SIEV019
      DO 100 I=1,N                                                      SIEV020
      XX=E1+DG1*FLOAT (I)                                               SIEV021
      IF(XX.LT.E2)GO TO 107                                             SIEV022
      GO TO 100                                                         SIEV0221
  107 NX=NX+1                                                           SIEV023
      EX(NX)=XX                                                         SIEV024
      IF(G1.LT.DP1)GO TO 1003                                           SIEV025
      GO TO 100                                                         SIEV0251
 1003 JFLAG(NX)=1                                                       SIEV026
  100 CONTINUE                                                          SIEV027
      DO 200 I=1,N                                                      SIEV028
      XX=E2-DG2*FLOAT (I)                                               SIEV029
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      IF(XX.GT.E1)GO TO 108                                                  SIEV030
      GO TO 200                                                              SIEV0301
  108 NX=NX+1                                                                SIEV031
      EX(NX)=XX                                                              SIEV032
      IF(G2.LT.DP2)GO TO 1005                                                SIEV033
      GO TO 200                                                              SIEV0331
 1005 JFLAG(NX)=1                                                            SIEV034
  200 CONTINUE                                                               SIEV035
  110 DIFF=(E2-E1)/FLOAT (N2)                                                SIEV036
      IF(DIFF)101,102,102                                                    SIEV037
  101 PRINT103                                                               SIEV038
      PRINT2000,E1,E2,DIFF                                                   SIEV039
      GO TO 104                                                              SIEV040
  103 FORMAT(32H CALLING SEQUENCE OF SIEVE WRONG)                            SIEV0411
 2000 FORMAT(4H E1=E13.6,4H E2=E13.6,6H DIFF=E13.6)                          SIEV042
  102 N21=NX+1                                                               SIEV043
      NN=NX                                                                  SIEV044
      N22=N21+N2-2                                                           SIEV045
      NX=N22                                                                 SIEV046
      E21=(E1+E2)/2.0                                                        SIEV047
      DP12=DP*SQRT (E21)                                                     SIEV048
      E43=E2-E1-((G1+G2)/2.0)                                                SIEV049
      IF(E43.LT.DP12)GO TO 1006                                              SIEV050
      GO TO 1007                                                             SIEV0501
 1006 DO 111 I=N21,N22                                                       SIEV051
      I2=I-NN                                                                SIEV052
      EX(I)=E1+DIFF*FLOAT (I2)                                               SIEV053
      JFLAG(I)=1                                                             SIEV054
  111 CONTINUE                                                               SIEV055
      GO TO 1040                                                             SIEV056
 1007 DO 112 I=N21,N22                                                       SIEV057
      I2=I-NN                                                                SIEV058
      EX(I)=E1+DIFF*FLOAT (I2)                                               SIEV059
      DPTEST=DP*SQRT (EX(I))                                                 SIEV060
      IF(EX(I).LE.E21)GO TO 1008                                             SIEV061
      GO TO 1009                                                             SIEV0611
 1008 IF(G1.LT.DPTEST)GO TO 1010                                             SIEV062
      GO TO 112                                                              SIEV0621
 1010 JFLAG(I)=1                                                             SIEV063
      GO TO 112                                                              SIEV064
 1009 IF(G2.LT.DPTEST)GO TO 1011                                             SIEV065
      GO TO 112                                                              SIEV0651
 1011 JFLAG(I)=1                                                             SIEV066
  112 CONTINUE                                                               SIEV067
 1040 DO 113 I=1,NX                                                          SIEV068
      DPF=DP*SQRT (EX(I))                                                    SIEV069
      IF(DPF.EQ.0.0)GO TO 113                                                SIEV0691
      TERM=EX(I)/DPF                                                         SIEV070
      IF(TERM.LT.25.)GO TO 114                                               SIEV071
      GO TO 113                                                              SIEV0711
  114 JFLAG(I)=1                                                             SIEV072
  113 CONTINUE                                                               SIEV073
  104 RETURN                                                                 SIEV074
      END                                                                    SIEV075
      SUBROUTINE RMSIGM(Q,KK)                                                RMSG001
      COMMON/E/XMIN(6),XMAX(6),XREF(6)                                       RMSG002
      COMMON ARAY,IRAY,ERAY,NOT,ZAI,ABN,NER,LFW,EL,EH,LRU,LRF,LANG,NLS,      RMSG003
     1NRES,LN,JN,PENFAR,SHIFAR,SPI,AP,AWRI,AM,DREF,AREF,BREF,IRANGE,NIS,     RMSG004
     3INCROSS,IVSPIN,ELO,TEFF,DELTA,E,AWR                                    RMSG005
      DIMENSION ARAY(6,500),IRAY(3,500),ERAY(2,500),NOT(20),ZAI(10),         RMSG006
     1ABN(10),NER(10),LFW(10),EL(10,10),EH(10,10),LRU(10,10),LRF(10,10),     RMSG007
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     2LANG(10,5,5),NLS(10,10),NRES(10),LN(50),JN(150),PENFAR(500),      RMSG008
     3SHIFAR(500),SPI(10),AP(10),AWRI(10),AM(10),DREF(6),AREF(6),BREF(6,RMSG009
     410)                                                               RMSG010
      DOUBLEPRECISIONR,S,RI,SI,B,DEN,DIFF,P1,R2,RHO1,RHO2,GJ,T1,T2,T3,T4RMSG011
     1,TERMT,TERMN,TERMF,TERMA,TERMG,SIGNNI,SIGNGI,SIGNFI,SIGNAI,SIGNTI,RMSG012
     2BETA,TRM,SIGP,CONSTE,CONSTA,PI,PS                                 RMSG013
      DIMENSION R(3,3),S(3,3),RI(3,3),SI(3,3),B(3,3)                    RMSG014
C---a-THIS SUBROUTINE USES THE FROBENIUS-SCHUR METHOD FOR INVERTING THE RMSG015
C-----COMPLEX MATRIX.                                                   RMSG016
      PI=3.141592653590+00                                              RMSG017
      Q2=SQRT(Q)                                                        RMSG018
      DO 4 J=1,6                                                        RMSG019
      AREF(J)=0.0                                                       RMSG020
      DO 5 K=1,10                                                       RMSG021
      BREF(J,K)=0.0                                                     RMSG022
    5 CONTINUE                                                          RMSG023
    4 CONTINUE                                                          RMSG024
      L2=0                                                              RMSG025
      N2=0                                                              RMSG026
      LA=0                                                              RMSG027
      JA=0                                                              RMSG028
      NTR=0                                                             RMSG029
      DO 112 I=1,NIS                                                    RMSG030
      NRESI=NRES(I)                                                     RMSG031
      API=AP(I)                                                         RMSG032
      XWR=AWRI(I)                                                       RMSG033
      YWR=XWR*1.008665                                                  RMSG034
      YWR=YWR**(1.0/3.0)                                                RMSG035
      APX=0.123*YWR+0.08                                                RMSG036
    3 NTR=NTR+NRESI                                                     RMSG037
      IF(NRESI)110,110,100                                              RMSG038
  100 LA=LA+1                                                           RMSG039
  102 L2=L2+LN(LA)                                                      RMSG040
      CALL FACTS(Q,IRAY(1,L2),PF,SF,PX,CONSTE,XWR,APX,3.0)              RMSG041
      CALL FACTS(Q,IRAY(1,L2),PX,SX,PS,CONSTE,XWR,API,3.0)              RMSG042
      SIGNNI=0.0                                                        RMSG043
      SIGNGI=0.0                                                        RMSG044
      SIGNFI=0.0                                                        RMSG045
      SIGNAI=0.0                                                        RMSG046
      SIGNTI=0.0                                                        RMSG047
  103 JA=JA+1                                                           RMSG048
  104 N1=N2+1                                                           RMSG049
      N2=N2+JN(JA)                                                      RMSG050
      GJ=2.0*(2.0*SPI(I)+1.0)                                           RMSG051
      GJ=(2.0*ARAY(2,N1)+1.0)/GJ                                        RMSG052
 3001 DO 7 J=1,3                                                        RMSG053
      DO 8 K=1,3                                                        RMSG054
      S(J,K)=0.0                                                        RMSG055
      IF(J.EQ.K)GO TO 9                                                 RMSG056
      GO TO 10                                                          RMSG057
    9 R(J,K)=1.0                                                        RMSG058
      GO TO 8                                                           RMSG059
   10 R(J,K)=0.0                                                        RMSG060
    8 CONTINUE                                                          RMSG061
    7 CONTINUE                                                          RMSG062
      DO 108 K=N1,N2                                                    RMSG063
      DIFF=ARAY(1,K)-Q                                                  RMSG064
      A1=ARAY(3,K)                                                      RMSG065
      A1=(A1*PF)/PENFAR(K)                                              RMSG066
      A1=SQRT(A1)                                                       RMSG067
      A2=ARAY(5,K)                                                      RMSG068
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      IF(A2)200,201,202                                                  RMSG069
  200 A2=-SQRT(-A2)                                                      RMSG070
      GO TO 300                                                          RMSG071
  201 A2=0.0                                                             RMSG072
      GO TO 300                                                          RMSG073
  202 A2=SQRT(A2)                                                        RMSG074
  300 A3=ARAY(6,K)                                                       RMSG075
      IF(A3)301,302,303                                                  RMSG076
  301 A3=-SQRT(-A3)                                                      RMSG077
      GO TO 400                                                          RMSG078
  302 A3=0.0                                                             RMSG079
      GO TO 400                                                          RMSG080
  303 A3=SQRT(A3)                                                        RMSG081
  400 DEN=DIFF**2+0.25*ARAY(4,K)*ARAY(4,K)                               RMSG082
      R(1,1)=R(1,1)+((0.25*ARAY(4,K)*A1*A1)/DEN)                         RMSG083
      S(1,1)=S(1,1)-((0.5*DIFF*A1*A1)/DEN)                               RMSG084
      R(1,2)=R(1,2)+((0.25*ARAY(4,K)*A1*A2)/DEN)                         RMSG085
      S(1,2)=S(1,2)-((0.5*DIFF*A1*A2)/DEN)                               RMSG086
      R(1,3)=R(1,3)+((0.25*ARAY(4,K)*A1*A3)/DEN)                         RMSG087
      S(1,3)=S(1,3)-((0.5*DIFF*A1*A3)/DEN)                               RMSG088
      R(2,2)=R(2,2)+((0.25*ARAY(4,K)*A2*A2)/DEN)                         RMSG089
      S(2,2)=S(2,2)-((0.5*DIFF*A2*A2)/DEN)                               RMSG090
      R(3,3)=R(3,3)+((0.25*ARAY(4,K)*A3*A3)/DEN)                         RMSG091
      S(3,3)=S(3,3)-((0.5*DIFF*A3*A3)/DEN)                               RMSG092
      R(2,3)=R(2,3)+((0.25*ARAY(4,K)*A2*A3)/DEN)                         RMSG093
      S(2,3)=S(2,3)-((0.5*DIFF*A2*A3)/DEN)                               RMSG094
  108 CONTINUE                                                           RMSG095
      R(2,1)=R(1,2)                                                      RMSG096
      S(2,1)=S(1,2)                                                      RMSG097
      R(3,1)=R(1,3)                                                      RMSG098
      S(3,1)=S(1,3)                                                      RMSG099
      R(3,2)=R(2,3)                                                      RMSG100
      S(3,2)=S(2,3)                                                      RMSG101
      DO 11 JJJ=1,3                                                      RMSG102
      DO 12 KKK=1,3                                                      RMSG103
      B(JJJ,KKK)=R(JJJ,KKK)                                              RMSG104
   12 CONTINUE                                                           RMSG105
   11 CONTINUE                                                           RMSG106
      CALL FROBNS(R,S,RI,SI)                                             RMSG107
      RHO1=RI(1,1)                                                       RMSG108
      RHO2=SI(1,1)                                                       RMSG109
      P1=DCOS(2.0*PS)                                                    RMSG110
      P2=-DSIN(2.0*PS)                                                   RMSG111
      TERMT=(1.0-P1*(2.0*RHO1-1.0)+2.0*P2*RHO2)*2.0                      RMSG112
      TERMT=GJ*TERMT-4.0*GJ*DSIN(PS)*DSIN(PS)                            RMSG113
      T1=RI(1,2)                                                         RMSG114
      T2=SI(1,2)                                                         RMSG115
      T3=RI(1,3)                                                         RMSG116
      T4=SI(1,3)                                                         RMSG117
      TERMF=GJ*(T1**2+T2**2+T3**2+T4**2)*4.0                             RMSG118
      TERMG=(RHO1**2+RHO2**2)*(B(1,1)-1.0)+(T1**2+T2**2)*(B(2,2)-1.0)+   RMSG119
     1(T3**2+T4**2)*(B(3,3)-1.0)                                         RMSG120
      TERMG=TERMG+2.0*(RHO1*T1+RHO2*T2)*B(1,2)+2.0*(RHO1*T3+RHO2*T4)*    RMSG121
     1B(1,3)+2.0*(T1*T3+T2*T4)*B(2,3)                                    RMSG122
      TERMG=4.0*GJ*TERMG                                                 RMSG123
      TERMN=TERMT-TERMF-TERMG                                            RMSG124
      SIGNNI=SIGNNI+TERMN                                                RMSG125
      SIGNGI=SIGNGI+TERMG                                                RMSG126
      SIGNFI=SIGNFI+TERMF                                                RMSG127
      SIGNTI=SIGNTI+TERMT                                                RMSG128
      IF(L2-N2)109,109,103                                               RMSG129
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  109 BETA=PI*ABN(I)/(CONSTE*CONSTE)                                    RMSG130
      AREF(1)=AREF(1)+SIGNNI*BETA                                       RMSG131
      AREF(2)=AREF(2)+SIGNGI*BETA                                       RMSG132
      AREF(3)=AREF(3)+SIGNFI*BETA                                       RMSG133
      AREF(4)=AREF(4)+SIGNTI*BETA                                       RMSG134
      BREF(1,I)=BREF(1,I)+SIGNNI*BETA                                   RMSG135
      BREF(2,I)=BREF(2,I)+SIGNGI*BETA                                   RMSG136
      BREF(3,I)=BREF(3,I)+SIGNFI*BETA                                   RMSG137
      BREF(4,I)=BREF(4,I)+SIGNTI*BETA                                   RMSG138
      IF(L2-NTR)100,110,110                                             RMSG139
  110 SIGP=0.0                                                          RMSG140
      LRUJK=LRU(I,KK)                                                   RMSG141
      IF(LRUJK-1)1250,1250,125                                          RMSG142
 1250 NLSKK=NLS(I,KK)                                                   RMSG143
      DO 126 LL=1,NLSKK                                                 RMSG144
      LURE=LANG(I,KK,LL)                                                RMSG145
      SS=FLOAT(LURE)                                                    RMSG146
      CALL FACTS(Q,LURE,PZ,SZ,PS,CONSTA,XWR,API,3,0)                    RMSG147
      TRM=(2.0*SS+1.0)*4.0*PI                                           RMSG148
      TRM=TRM*DSIN(PS)*DSIN(PS)/(CONSTA*CONSTA)                         RMSG149
      SIGP=SIGP+TRM                                                     RMSG150
  126 CONTINUE                                                          RMSG151
  125 AREF(1)=AREF(1)+SIGP*ABN(I)                                       RMSG152
      AREF(4)=AREF(4)+SIGP*ABN(I)                                       RMSG153
      BREF(1,I)=BREF(1,I)+SIGP*ABN(I)                                   RMSG154
      BREF(4,I)=BREF(4,I)+SIGP*ABN(I)                                   RMSG155
  112 CONTINUE                                                          RMSG156
      RETURN                                                            RMSG157
      END                                                               RMSG158
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MOCK PU-241 RAMP1 TEST DATA,        0550.0    11     4    1.0E-04
   940241.0    238.9859              0            0            1            0
   940241.0       1.0                0            1            1            0
         1.0     20.0                1            3            0            0
         2.5    0.9772               0            0            1            0
   238.9859       0.0                0            0           90           15
     -0.160       2.0   0.029E-03     4.0E-02  4.000E-02  2.000E-02
      0.260       3.0   0.051E-03     4.0E-02  5.000E-02  2.500E-02
      4.300       2.0   0.660E-03     4.0E-02 -1.600E-02  1.600E-02
      4.580       3.0   0.430E-03     4.0E-02  8.000E-02  8.000E-02
      5.920       2.0   2.430E-03     4.0E-02100.000E-02-35.000E-02
      6.930       3.0   0.710E-03     4.0E-02  3.500E-02  6.000E-02
      8.600       2.0   1.000E-03     4.0E-02 -2.000E-02  6.000E-02
      9.500       3.0   0.180E-03     4.0E-02 -4.000E-02  8.000E-02
     10.100       2.0   1.500E-03     4.0E-02  0.000E-02 90.000E-02
     12.780       3.0   0.790E-03     4.0E-02 20.000E-02  3.500E-02
     13.400       2.0   2.200E-03     4.0E-02  1.400E-02  2.500E-02
     14.750       3.0   6.200E-03     4.0E-02  1.400E-02  1.400E-02
     15.980       2.0   1.520E-03     4.0E-02 40.000E-02  6.500E-02
     16.690       3.0   1.230E-03     4.0E-02 10.000E-02  8.000E-02
     17.830       2.0   3.200E-03     4.0E-02 -0.300E-02  2.000E-02
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PROGRAM RAMP1, PROGRAM TO CALCULATE CROSS-SECTIONS ACCORDING TO THE REICH-MOORE FORMALISM, USES ENDF/B VERSION II

TITLE MOCK PU-241 RAMP1 TEST DATA,

(Z,A) DESIGNATION OF THE ELEMENT 9,4024E+05 AT.WT/MASS OF NEUTRON 2,3899E+02 NO OF ISOTOPES 1

DATA FOR ISOTOPE NUMBER 1

(Z,A) DESIGNATION OF THE ISOTOPE 9,4024E+05 FRACTIONAL ABUNDANCE 1,0000E+00 NO OF ENERGY RANGES 1
LOWER LIMIT OF THE ENERGY RANGE(EV) 1,0000E+00 UPPER LIMIT(EV) 2,0000E+01 LRU= 1 LRF= 3
NUCLEAR SPIN 2,5000E+00 SCATTERING LENGTH 9,7720E-01 NO OF L-VALUES 1
MASS OF THE ISOTOPE IN UNITS OF NEUTRON MASS 2,3899E+02 SCATTERING LENGTH(A=) 0,0000E+00 ANGULAR MOMENTUM 0 NO OF RESO

ERES	SPIN	GN	GGAMMA	GFA	GFB
-1,6000E-01	2,0000E+00	2,9000E-05	4,0000E-02	4,0000E-02	2,0000E-02
2,6000E-01	3,0000E+00	5,1000E-05	4,0000E-02	5,0000E-02	2,5000E-02
4,3000E+00	2,0000E+00	6,6000E-04	4,0000E-02	-1,6000E-02	1,6000E-02
4,5800E+00	3,0000E+00	4,3000E-04	4,0000E-02	8,0000E-02	8,0000E-02
5,9200E+00	2,0000E+00	2,4300E-03	4,0000E-02	1,0000E+00	-3,5000E-01
6,9300E+00	3,0000E+00	7,1000E-04	4,0000E-02	3,5000E-02	6,0000E-02
8,6000E+00	2,0000E+00	1,0000E-03	4,0000E-02	-2,0000E-02	6,0000E-02
9,5000E+00	3,0000E+00	1,8000E-04	4,0000E-02	-4,0000E-02	8,0000E-02
1,0100E+01	2,0000E+00	1,5000E-03	4,0000E-02	0,0000E+00	9,0000E-01
1,2780E+01	3,0000E+00	7,9000E-04	4,0000E-02	2,0000E-01	3,5000E-02
1,3400E+01	2,0000E+00	2,2000E-03	4,0000E-02	1,4000E-02	2,5000E-02
1,4750E+01	3,0000E+00	6,2000E-03	4,0000E-02	1,4000E-02	1,4000E-02
1,5980E+01	2,0000E+00	1,5200E-03	4,0000E-02	4,0000E-01	6,5000E-02
1,6690E+01	3,0000E+00	1,2300E-03	4,0000E-02	1,0000E-01	8,0000E-02
1,7830E+01	2,0000E+00	3,2000E-03	4,0000E-02	-3,0000E-03	2,0000E-02

CROSS-SECTIONS AT THERMAL ENERGY

NEUTRON ENERGY(EV)	SIGNN	SIGCAP	SIGF	SIGTOTAL
2,530000E-02	9,968436E+00	3,062950E+02	5,856657E+02	9,019291E+02

NEUTRON ENERGY(EV)	SIGNN	SIGCAP	SIGF	SIGTOTAL

1,000000E+00	1.058544E+01	4,900407E+00	6,772793E+00	2,225864E+01
1,036330E+00	1.055058E+01	4,552330E+00	6,920150E+00	2,202306E+01
1,072660E+00	1.051761E+01	4,253114E+00	7,085793E+00	2,185652E+01
1,825000E+00	1.001607E+01	2,271752E+00	1,118875E+01	2,347657E+01
2,650000E+00	9.478008E+00	2,614635E+00	1,666293E+01	2,875557E+01
3,475000E+00	8.536163E+00	5,725111E+00	2,680162E+01	4,106289E+01
4,227340E+00	5.104560E+00	2,650225E+02	1,355504E+02	4,056774E+02
4,263670E+00	8.831456E+00	6,450148E+02	3,402282E+02	9,940745E+02
4,300000E+00	3.043822E+01	1,584601E+03	1,069601E+03	2,684640E+03
4,336330E+00	3.186469E+01	9,107009E+02	9,132591E+02	1,855825E+03
4,370000E+00	2,108056E+01	3,779431E+02	5,675073E+02	9,665309E+02
4,372660E+00	2.052070E+01	3,567806E+02	5,526902E+02	9,299915E+02
4,379570E+00	1.921911E+01	3,099162E+02	5,199569E+02	8,490922E+02
4,440000E+00	1.322645E+01	1,463447E+02	4,368031E+02	5,963742E+02
4,479785E+00	1.177551E+01	1,314830E+02	4,885665E+02	6,318250E+02
4,510000E+00	1.150440E+01	1,400460E+02	5,650123E+02	7,165627E+02
4,580000E+00	1.384179E+01	1,699030E+02	7,029183E+02	8,866631E+02
4,680215E+00	1.510298E+01	8,895554E+01	3,722261E+02	4,762846E+02
4,780430E+00	1.332331E+01	4,045471E+01	2,030781E+02	2,568561E+02
4,915000E+00	1.183322E+01	2,079535E+01	1,519174E+02	1,845459E+02
5,223785E+00	1.036864E+01	1,163614E+01	1,708226E+02	1,928274E+02
5,250000E+00	1.030179E+01	1,147385E+01	1,754491E+02	1,972248E+02
5,585000E+00	9.990475E+00	1,203536E+01	2,565913E+02	2,786171E+02
5,920000E+00	1.065095E+01	1,366816E+01	3,219918E+02	3,463109E+02
6,172500E+00	1.115306E+01	1,348941E+01	3,000274E+02	3,246699E+02
6,425000E+00	1,091760E+01	1,446035E+01	2,438126E+02	2,691905E+02
6,616215E+00	1,004552E+01	2,218022E+01	2,202129E+02	2,524387E+02
6,677500E+00	9.570393E+00	2,959330E+01	2,264784E+02	2,656421E+02
6,794290E+00	8.371799E+00	7,467768E+01	3,153549E+02	3,984044E+02
6,862145E+00	8.879052E+00	1,775740E+02	5,515465E+02	7,379996E+02
6,930000E+00	1.809265E+01	3,452943E+02	9,409558E+02	1,304343E+03
6,997855E+00	2,107452E+01	1,728051E+02	5,203538E+02	7,142335E+02
7,065710E+00	1,792169E+01	7,144360E+01	2,726230E+02	3,619883E+02
7,347500E+00	1,344669E+01	1,236468E+01	1,138863E+02	1,396976E+02
7,765000E+00	1,166345E+01	6,508113E+00	9,027773E+01	1,084493E+02
8,182500E+00	1.025646E+01	1,088876E+01	1,142373E+02	1,353825E+02
8,479000E+00	9.194361E+00	7,555025E+01	3,162147E+02	4,009593E+02
8,539500E+00	1,204646E+01	1,851301E+02	5,432464E+02	7,404229E+02
8,600000E+00	2.572665E+01	3,831015E+02	7,050983E+02	1,113926E+03
8,660500E+00	2.454734E+01	1,891886E+02	1,836176E+02	3,973535E+02
8,721000E+00	1,864061E+01	7,491894E+01	2,864011E+01	1,221997E+02
8,825000E+00	1.468965E+01	2,658259E+01	3,616975E+00	4,488922E+01
9,050000E+00	1,213703E+01	1,003372E+01	2,632857E+01	4,849932E+01
9,275000E+00	1,090433E+01	1,096461E+01	6,047112E+01	8,234005E+01
9,339820E+00	1,054623E+01	1,473751E+01	7,964074E+01	1,049245E+02
9,419910E+00	1,016821E+01	2,829259E+01	1,305088E+02	1,689696E+02
9,500000E+00	1,119660E+01	5,097808E+01	2,142998E+02	2,764744E+02
9,580090E+00	1,216397E+01	2,855911E+01	1,639949E+02	2,047180E+02
9,629250E+00	1.198685E+01	1,877122E+01	1,430153E+02	1,737734E+02
9,650000E+00	1,190027E+01	1,639476E+01	1,395057E+02	1,678008E+02
9,660180E+00	1.186079E+01	1,547843E+01	1,385668E+02	1,659060E+02
9,800000E+00	1.160841E+01	1,061038E+01	1,504076E+02	1,726264E+02
9,950000E+00	1,186901E+01	1,025375E+01	1,728589E+02	1,949816E+02
1,010000E+01	1,242248E+01	1,001515E+01	1,730137E+02	1,954513E+02
1,057075E+01	1.253795E+01	5,386169E+00	6,741065E+01	8,533478E+01
1,077000E+01	1,208537E+01	4,153931E+00	4,115512E+01	5,739442E+01
1,104150E+01	1,147766E+01	3,316095E+00	2,293927E+01	3,773303E+01
1,144000E+01	1,065231E+01	3,060883E+00	1,302784E+01	2,674104E+01
1,211000E+01	9.055921E+00	5,067992E+00	1,926266E+01	3,338657E+01
1,250421E+01	7.469381E+00	1,438958E+01	7,350651E+01	9,536547E+01
1,264210E+01	7.049704E+00	3,017804E+01	1,655657E+02	2,027934E+02

```
C      PROGRAM ADLER(INPUT,OUTPUT)                                          ADLR001
       COMMON/D/ERAN(2,501)                                                 ADLR002
       COMMON/C/EX(101),JFLAG(101)                                          ADLR003
       COMMON ARAY1(6,500),ARAY2(6,500),NOT(20),ZAI(20),ABN(10),            ADLR004
      1NER(10),LFW(10),EL(10,10),EH(10,10),LRU(10,10),LRF(10,10),           ADLR005
      2LANG(10,5,5),NLS(10,10),NRES(10),SPI(10),AP(10),LIS(10),AM(10),      ADLR006
      3AWRJ(10),LI(10),NXX(10),ABG(10,6,3),NJS(10,5,5),AJ(10,5,5),          ADLR007
      4AREF(6),TEFF,DELTA,E                                                 ADLR008
       DIMENSION TITLE(7)                                                   ADLR009
       EXTERNAL MOV,KOM                                                     ADLR010
       EXTERNAL MOVE,KOME                                                   ADLR011
       DATA MAXPTS,MAXRES,ETHERM/2000,100,0.253E-01/                        ADLR012
C---THIS IS A PROGRAM TO CALCULATE TOTAL,CAPTURE AND FISSION CROSS-          ADLR013
C---SECTIONS FROM THE CORRESPONDING ADLER-ADLER PARAMETERS. THERE IS         ADLR014
C---OPTION FOR DOPPLER BROADENING USING THE CONVENTIONAL PSI AND CHI         ADLR015
C---FUNCTIONS,NOTE THAT THE CONSTANT C=E(EV)*PI*(LAMBDA-BAR)**2 IS NOTADLR016
C---INCLUDED IN THE ADLER PARAMETERS G AND H AS IT IS DONE IN SOME           ADLR017
C---EVALUATIONS. RUNS ON BOTH CDC-6600 AND PDP-10.                          ADLR018
C---ENDF/B VERSION II DATA                                                  ADLR019
C      1111111111111111111111111111111111111111111111111111111111111111111ADLR020
             READ1,(TITLE(I),I=1,7),IDPL,TEFF                              ADLR021
C---IDPL=1 IF DOPPLER BROADENED CROSS-SECTIONS ARE DESIRED,ELSE IDPL=0ADLR022
C---TEFF=EFFECTIVE TEMPERATURE OF THE TARGET IN DEGREES KELVIN.             ADLR023
                    PRINT42                                                 ADLR024
                    PRINT25                                                 ADLR025
                    PRINT43                                                 ADLR026
                    PRINT25                                                 ADLR027
                    PRINT24,(TITLE(I),I=1,7)                                ADLR028
       PRINT25                                                              ADLR029
                    PRINT2,IDPL,TEFF                                        ADLR030
       PRINT25                                                              ADLR031
    1 FORMAT(7A4,2X,I5,F5.1)                                                ADLR032
C      22222222222222222222222222222222222222222222222222222222222222222ADLR033
 1013               READ3,ZA,AWR,NOT(1),NOT(2),NIS,NOT(3)                   ADLR034
C---ZA=(Z,A)DESIGNATION OF MATERIAL,AWR=AT.WT/NEUTRON MASS.NIS=NO OF        ADLR035
C---ISOTOPES                                                                ADLR036
                    PRINT17,ZA,AWR,NIS                                      ADLR037
       PRINT25                                                              ADLR038
       J1=1                                                                 ADLR039
       JFID=1                                                               ADLR040
       DO 101 I=1,NIS                                                       ADLR041
       NRANGE=1                                                             ADLR042
C      33333333333333333333333333333333333333333333333333333333333333333ADLR043
       PRINT25                                                              ADLR044
                    PRINT18,I                                               ADLR045
       PRINT25                                                              ADLR046
                    READ3,ZAI(I),ABN(I),NOT(4),LFW(I),NER(I),NOT(5)         ADLR047
C---ZAI(I)=(Z,A) DESIGNATION OF ITH ISOTOPE ABN(I)=WT FRACTION OF ITH       ADLR048
C---ISOTOPE LFW=1 FISSION WIDTHS ARE GIVEN,=0 FISSION WIDTHS NOT GIVENADLR049
C---NER(I)=NO OF ENERGY RANGES USED                                         ADLR050
                    PRINT19,ZAI(I),ABN(I),NER(I)                            ADLR051
       NERI=NER(I)                                                          ADLR052
       J2=1                                                                 ADLR053
C      44444444444444444444444444444444444444444444444444444444444444444ADLR054
  106              READ3,EL(I,J2),EH(I,J2),LRU(I,J2),LRF(I,J2),NOT(6),NOADLR055
     1T(7)                                                                  ADLR056
C---EL=LOWER ENERGY LIMIT OF A RANGE, EH=UPPER LIMIT OF A RANGE             ADLR057
C---LRU=1 RESOLVED RESONANCE PARAMETERS,LRU=2 UNRESOLVED  PARAMTRS          ADLR058
C---LRF=4 INDICATES THAT THE ADLER-ADLER FORMULAE SHOULD BE USED TO         ADLR059
C---CALCULATE CROSS-SECTIONS.                                               ADLR060
                    PRINT20,EL(I,J2),EH(I,J2),LRU(I,J2),LRF(I,J2)           ADLR061
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      LRUIJ=LRU(I,J2)                                                   ADLR062
      IF(LRUIJ-1)127,128,1010                                           ADLR063
  127 PRINT10                                                           ADLR064
      GO TO 130                                                         ADLR065
  128 NMOM=1                                                            ADLR066
C     555555555555555555555555555555555555555555555555555555555555555ADLR067
                  READ3,SPI(I),AP(I),NOT(7),NOT(8),NLS(I,J2),NOT(9)     ADLR068
C-----SPI(I)=SPIN OF THE I-TH ISOTOPE,AP(I)=A+ SPIN DEPENDENT SCATTERINGADLR069
C-----LENGTH IN UNITS OF 1.0E-12CM,AM(I)=A-, FOR SPIN INDEPENDENCEAM(I)=ADLR070
C-----NLS=NUMBER OF L-VALUES,                                           ADLR071
                  PRINT21,SPI(I),AP(I),NLS(I,J2)                        ADLR072
      JL=1                                                              ADLR073
C     666666666666666666666666666666666666666666666666666666666666666ADLR074
  104             READ3,AWRJ(I),NOT(11),LI(I),NOT(12),NX6X,NXX(I)       ADLR075
                  PRINT37,AWRJ(I)                                       ADLR076
                  PRINT41,LI(I)                                         ADLR077
                  PRINT38,NXX(I)                                        ADLR078
      PRINT25                                                           ADLR079
C-----AWRJ(I)=RATIO OF THE MASS OF THE I-TH NUCLEUS TO THE NEUTRON MASS,ADLR080
C-----LI(I)=5 IF TOTAL AND CAPTURE ,LI(I)=6 IF FISSION AND CAPTURE AND  ADLR081
C-----LI(I)=7 IF TOTAL,CAPTURE AND FISSION CROSS-SECTIONS ARE GIVEN.     ADLR082
C-----NXX(I)=2 IF THE BACKGROUND PARAMETERS ARE GIVEN FOR THE           ADLR083
C-----TOTAL AND CAPTURE CROSS-SECTIONS, NXX(I)=3 IF THE BACKGROUND PARA-ADLR084
C-----METERS ARE GIVEN FOR TOTAL,CAPTURE AND FISSION CROSS-SECTIONS,     ADLR085
      NMOM=NMOM+1                                                       ADLR086
      NXXI=NXX(I)                                                       ADLR087
C     777777777777777777777777777777777777777777777777777777777777777ADLR088
      DO 1001 J=1,NXXI                                                  ADLR089
                  READ4,(ABG(I,K,J),K=1,6)                              ADLR090
      GO TO (1002,1003,1004),J                                          ADLR091
 1002 PRINT33                                                           ADLR092
      GO TO 1005                                                        ADLR093
 1003 PRINT34                                                           ADLR094
      GO TO 1005                                                        ADLR095
 1004 PRINT35                                                           ADLR096
 1005 PRINT36,(ABG(I,K,J),K=1,6)                                        ADLR097
      PRINT25                                                           ADLR098
 1001 CONTINUE                                                          ADLR099
C-----ABG(I,K,J) ARE THE BACKGROUND PARAMETERS WHICH ARE SUPPOSED TO ACCADLR100
C-----OUNT FOR THE TAILS OF RESONANCES WHICH ARE OUTSIDE THE ENERGY RANGADLR101
C-----E UNDER CONSIDERATION,                                            ADLR102
C     888888888888888888888888888888888888888888888888888888888888888ADLR103
                  READ3,NOT(13),NOT(14),LANG(I,J2,JL),NOT(15),NJS(I,J2,ADLR104
     1JL),NOT(16)                                                       ADLR105
C-----LANG(I,J2,JL) GIVES THE ANGULAR MOMENTUM OF THE RESONANCES, NJS ISADLR106
C-----THE NUMBER OF J-VALUES,                                           ADLR107
                  PRINT39,LANG(I,J2,JL),NJS(I,J2,JL)                    ADLR108
      NJSIJ=NJS(I,J2,JL)                                                ADLR109
      J4=1                                                              ADLR110
C     999999999999999999999999999999999999999999999999999999999999999ADLR111
  202             READ3,AJ(I,J2,JL),AM(I),NOT(17),NOT(18),NLJ12,NLJ     ADLR112
      PRINT25                                                           ADLR113
                  PRINT40,AJ(I,J2,JL),NLJ                               ADLR114
C-----AJ GIVES THE SPIN OF THE RESONANCES IN THIS GROUP, THIS SHOULD BE ADLR115
C-----A FOUR DIMENSIONAL ARRAY, SINCE A FOUR DIMENSIONAL ARRAY CANNOT BEADLR116
C----- HANDLED BY THE CDC-6600 AND SINCE WE DO NOT USE THIS INFORMATION ADLR117
C-----ANYWAY, WE HAVE LEFT THIS HERE AS A THREE DIMENSIONAL ARRAY,      ADLR118
C-----AM(I)=A- SPIN DEPENDENT SCATTERING LENGTH IN UNITS OF 1.0E-12CM,  ADLR119
C-----AM(I)=0.0 AT PRESENT IN ENDF/B, NLJ= NUMBER OF RESONANCES WITH A  ADLR120
C-----GIVEN L AND J VALUE,                                              ADLR121
      J3=J1+(NLJ-1)                                                     ADLR122
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C     AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAADLR123
      DO 1000 J=J1,J3                                                    ADLR124
                  READ4,(ARAY1(K,J),K=1,6)                               ADLR125
                  READ4,(ARAY2(K,J),K=1,6)                               ADLR126
 1000 CONTINUE                                                           ADLR127
C-----THESE ARE THE ADLER-ADLER RESONANCE PARAMETERS.                    ADLR128
C-----ARAY1(1,J)=MUT,ARAY1(2,J)=NUT,ARAY1(3,J)=GT,ARAY1(4,J)=HT.        ADLR129
C-----ARAY1(5,J)=MUF,ARAY1(6,J)=NUF,ARAY2(1,J)=GF,ARAY2(2,J)=HF.        ADLR130
C-----ARAY2(3,J)=MUC,ARAY2(4,J)=NUC,ARAY2(5,J)=GC,ARAY2(6,J)=HC.        ADLR131
      PRINT25                                                            ADLR132
      PRINT 9                                                            ADLR133
      PRINT 25                                                           ADLR134
      PRINT30                                                            ADLR135
      PRINT23,(ARAY1(1,J),ARAY1(2,J),ARAY1(3,J),ARAY1(4,J),J=J1,J3)      ADLR136
      PRINT25                                                            ADLR137
      PRINT31                                                            ADLR138
      PRINT23,(ARAY1(5,J),ARAY1(6,J),ARAY2(1,J),ARAY2(2,J),J=J1,J3)      ADLR139
      PRINT25                                                            ADLR140
      PRINT32                                                            ADLR141
      PRINT23,(ARAY2(3,J),ARAY2(4,J),ARAY2(5,J),ARAY2(6,J),J=J1,J3)      ADLR142
      J1=J1+NLJ                                                          ADLR143
      J4=J4+1                                                            ADLR144
      IF(J4-NJSIJ)202,202,203                                            ADLR145
  203 JL=JL+1                                                            ADLR146
      PRINT25                                                            ADLR147
      IF(NMOM-NLS(I,J2))104,104,103                                      ADLR148
  103 NRANGE=NRANGE+1                                                    ADLR149
      J2=J2+1                                                            ADLR150
      IF(NRANGE-NERI)106,106,1010                                        ADLR160
 1010 NRES(I)=J1-JFID                                                    ADLR161
      JFID=J1                                                            ADLR162
  101 CONTINUE                                                           ADLR163
      NTOTAL=J1-1                                                        ADLR164
      PHI=3.14159265                                                     ADLR165
    2 FORMAT(26H OPTION TO DOPPLER BROADEN15,26H EFFECTIVE TEMPERATURE(*ADLR166
     1K)F10.3)                                                           ADLR167
    3 FORMAT(2E11.4,4I11)                                                ADLR168
    4 FORMAT(6E11.4)                                                     ADLR169
    8 FORMAT(2X,4(2X,E20.6,2X))                                          ADLR170
    9 FORMAT(40H ADLER-ADLER PARAMETERS FOR THIS ISOTOPE)                ADLR171
   10 FORMAT(20H ERROR IN INPUT DATA)                                    ADLR172
   11 FORMAT(44H ADLER-ADLER CROSS-SECTIONS FOR THIS ELEMENT)            ADLR173
   12 FORMAT(37H CROSS-SECTIONS NOT DOPPLER BROADENED)                   ADLR174
   13 FORMAT(33H CROSS-SECTIONS DOPPLER BROADENED)                       ADLR175
   14 FORMAT(98H       NEUTRON ENERGY(EV)        TOTAL X-SECTION        ADLR176
     1FISSION X-SECTION        CAPTURE X-SECTION)                      ADLR177
   17 FORMAT(33H (Z,A) DESIGNATION OF THE ELEMENTE11.4,22H AT.WT/MASS OFADLR178
     1 NEUTRONE11.4,15H NO OF ISOTOPESI5)                                ADLR179
   18 FORMAT(24H DATA FOR ISOTOPE NUMBERI5)                              ADLR180
   19 FORMAT(33H (Z,A) DESIGNATION OF THE ISOTOPEE11.4,21H FRACTIONAL ABADLR181
     1UNDANCEE11.4,20H NO OF ENERGY RANGESI5)                            ADLR182
   20 FORMAT(36H LOWER LIMIT OF THE ENERGY RANGE(EV)E11.4,18H   UPPER LIADLR183
     1MIT(EV)E11.4,6H  LRU=I5,6H  LRF=I5)                                ADLR184
   21 FORMAT(13H NUCLEAR SPINE11.4,18H SCATTERING LENGTHE11.4,15H NO OF ADLR185
     1L-VALUESI5)                                                        ADLR186
   22 FORMAT(41H CONSTANT USED TO CALCULATE PENETRABILITYE11.4,22H SCATTADLR187
     1ERING LENGTH(A-)E11.4,17H ANGULAR MOMENTUMI5,17H NO OF RESONANCESIADLR188
     25)                                                                 ADLR189
   23 FORMAT(2X,4(E20.6))                                                ADLR190
   24 FORMAT(11H TITLE     7A4)                                          ADLR191
   25 FORMAT(//)                                                         ADLR192
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   26 FORMAT(12(1X,F8.5,2X))                                                ADLR193
   27 FORMAT(33H CROSS-SECTIONS AT THERMAL ENERGY)                          ADLR194
   28 FORMAT(4(E13.6,1X,I1))                                                ADLR195
   29 FORMAT(30H THE BACKGROUND PARAMETERS ARE)                             ADLR196
   30 FORMAT(74H              MUT                    NUT                GT  ADLR197
     1              HT)                                                    ADLR198
   31 FORMAT(74H              MUF                    NUF                GF  ADLR199
     1              HF)                                                    ADLR200
   32 FORMAT(74H              MUC                    NUC                GC  ADLR201
     1              HC)                                                    ADLR202
   33 FORMAT(50H BACKGROUND PARAMETERS FOR THE TOTAL CROSS-SECTION)         ADLR203
   34 FORMAT(52H BACKGROUND PARAMETERS FOR THE FISSION CROSS-SECTION)       ADLR204
   35 FORMAT(52H BACKGROUND PARAMETERS FOR THE CAPTURE CROSS-SECTION)       ADLR205
   36 FORMAT(4H A1=E18.6,4H A2=E18.6,4H A3=E18.6,4H A4=E18.6,4H B1=E18.6ADLR206
     1,4H B2=E18.6)                                                         ADLR207
   37 FORMAT(48H MASS OF THIS ISOTOPE IN UNITS OF NEUTRON MASS  E11.4)      ADLR208
   38 FORMAT(4H NX=I5,102H IF NX=2 TOTAL AND CAPTURE BCKGRND PARAMETERS ADLR209
     1GIVEN.IF NX=3 TOTAL,CAPTURE AND FISSION PARAMETERS GIVEN)             ADLR210
   39 FORMAT(35H ANGULAR MOMENTUM OF THE RESONANCESI10,19H NUMBER OF J-SADLR211
     1TATESI10)                                                             ADLR212
   40 FORMAT(29H J-VALUE FOR THESE RESONANCESF5.2,57H NUMBER OF RESONANCADLR213
     1ES FOR THE ABOVE L-VALUE AND THIS J ISI10)                            ADLR214
   41 FORMAT(4H LI=I5,109H IF LI=5 TOTAL AND CAPTURE, LI=6 FISSION AND CADLR215
     1APTURE, AND LI=7 TOTAL CAPTURE AND FISSION CROSS-SECTIONS GIVEN)      ADLR216
   42 FORMAT(106H1 PROGRAM ADLER, CALCULATES CROSS-SECTIONS FROM ADLER-AADLR217
     1DLER PARAMETERS WITH OPTION FOR DOPPLER BROADENING,)                  ADLR218
   43 FORMAT(24H ENDF/B VERSION II DATA.)                                   ADLR219
      DO 108 I=1,NTOTAL                                                     ADLR220
      TERM1=ARAY1(1,I)                                                      ADLR221
      TERM2=ARAY1(2,I)                                                      ADLR222
      IF(TERM1.EQ.0.0.OR.TERM2.EQ.0.0)GO TO 1080                            ADLR223
      GO TO 1081                                                            ADLR2231
1080  TERM1=ARAY1(5,I)                                                      ADLR224
      TERM2=ARAY1(6,I)                                                      ADLR225
      IF(TERM1.EQ.0.0.OR.TERM2.EQ.0.0)GO TO 1082                            ADLR226
      GO TO 1083                                                            ADLR2261
1081  ERAN(1,I)=TERM1                                                       ADLR227
      ERAN(2,I)=TERM2                                                       ADLR228
      GO TO 108                                                             ADLR229
1082  TERM1=ARAY2(3,I)                                                      ADLR230
      TERM2=ARAY2(4,I)                                                      ADLR231
      IF(TERM1.EQ.0.0.OR.TERM2.EQ.0.0)GO TO 1084                            ADLR232
      GO TO 1085                                                            ADLR2321
1083  ERAN(1,I)=TERM1                                                       ADLR233
      ERAN(2,I)=TERM2                                                       ADLR234
      GO TO 108                                                             ADLR235
1084  PRINT10                                                               ADLR236
      GO TO 130                                                             ADLR237
1085  ERAN(1,I)=TERM1                                                       ADLR238
      ERAN(2,I)=TERM2                                                       ADLR239
 108  CONTINUE                                                              ADLR240
      CALL QIKS(1,NTOTAL,MOV,KOM)                                           ADLR241
      PRINT11                                                               ADLR242
      PRINT25                                                               ADLR243
      PRINT27                                                               ADLR244
      PRINT25                                                               ADLR245
      PRINT14                                                               ADLR246
      PRINT25                                                               ADLR247
      E=ETHERM                                                              ADLR248
      CALL ADSIGMA(E,NIS,1,0)                                               ADLR249
      PRINT8,E,(AREF(LL),LL=1,3)                                            ADLR250
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      PRINT25                                                          ADLR251
      IF(IDPL.EQ.1)GOTO1500                                            ADLR252
      PRINT12                                                          ADLR253
      PRINT25                                                          ADLR254
      GO TO 1501                                                       ADLR255
 1500 PRINT13                                                          ADLR256
      PRINT25                                                          ADLR257
 1501 PRINT14                                                          ADLR258
      PRINT25                                                          ADLR259
  120 CONTINUE                                                         ADLR260
      DO 124 JJ=1,NIS                                                  ADLR261
      NERJJ=NER(JJ)                                                    ADLR262
      DO 125 KK=1,NERJJ                                                ADLR263
      IRANGE=KK                                                        ADLR264
      LRUJK=LRU(JJ,KK)                                                 ADLR265
      IF(LRUJK-1)131,1321,125                                          ADLR266
  131 PRINT10                                                          ADLR267
      GO TO 130                                                        ADLR268
 1321 IF(JJ.EQ.1)GO TO 1320                                            ADLR269
      GO TO 132                                                        ADLR2691
 1320 ELOREF=EL(JJ,KK)                                                 ADLR270
      EHIREF=EH(JJ,KK)                                                 ADLR271
      ELO=ELOREF                                                       ADLR272
      EHI=EHIREF                                                       ADLR273
      GO TO 1240                                                       ADLR274
  132 ELO=EL(JJ,KK)                                                    ADLR275
      EHI=EH(JJ,KK)                                                    ADLR276
      IF(ELO.EQ.ELOREF.AND.EHI.EQ.EHIREF)GO TO 124                     ADLR277
      GO TO 1240                                                       ADLR2771
 1240 MM=MAXPTS/(4*MAXRES)                                             ADLR278
      NN=MM                                                            ADLR279
      IFLAG=1                                                          ADLR280
      NLSKK=NLS(JJ,KK)                                                 ADLR281
      J4=1                                                             ADLR282
      ISTART=1                                                         ADLR283
      IEND=1                                                           ADLR284
  117 IF(IEND.EQ.0)GO TO 125                                           ADLR285
      J5=J4+1                                                          ADLR286
      E1=ERAN(1,J4)                                                    ADLR287
      G1=ERAN(2,J4)                                                    ADLR288
      E2=ERAN(1,J5)                                                    ADLR289
      G2=ERAN(2,J5)                                                    ADLR290
      IF(E1.LT.ELO.AND.E2.LT.ELO)GO TO 1120                            ADLR291
      GO TO 1105                                                       ADLR2911
 1105 IF(E1.LE.ELO.AND.E2.GT.ELO)GO TO 1110                            ADLR292
      GO TO 1111                                                       ADLR2921
 1110 E1=ELO                                                           ADLR293
      G1=G2                                                            ADLR294
      ISTART=0                                                         ADLR295
      GO TO 1114                                                       ADLR296
 1111 IF(E1.GT.ELO.AND.E2.LE.EHI)GO TO 1112                            ADLR297
      GO TO 1113                                                       ADLR2971
 1112 IF(J4.EQ.1.AND.ISTART.EQ.1)GO TO 1106                            ADLR298
      GO TO 1114                                                       ADLR2981
 1106 E2=E1                                                            ADLR299
      G2=G1                                                            ADLR300
      E1=ELO                                                           ADLR301
      J4=J4-1                                                          ADLR302
      ISTART=0                                                         ADLR303
      GO TO 1114                                                       ADLR304
 1116 E2=EHI+G1/FLOAT (MM)                                             ADLR305
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1113 IF(E1.LT.EHI.AND.E2.GE.EHI)GO TO 1123                              ADLR309
     GO TO 1124                                                         ADLR3091
1123 E2=EHI                                                             ADLR310
     G2=G1                                                              ADLR311
     IEND=0                                                             ADLR312
     GO TO 1114                                                         ADLR313
1124 IF(E1.GE.EHI.AND.E2.GT.EHI)GO TO 125                               ADLR314
     GO TO 1125                                                         ADLR3141
1125 IF(IFLAG)1120,125,1120                                             ADLR315
1114 IF(E1.EQ.E2)GO TO 1120                                             ADLR316
     GO TO 1118                                                         ADLR3161
1118 CONTINUE                                                           ADLR317
     CALL SIEVE(E1,G1,E2,G2,MM,NN,NX,TEFF,AWR)                          ADLR318
     CALL QIKS(1,NX,MOVE,KOME)                                          ADLR319
     GO TO 116                                                          ADLR320
1120 IF(IEND.EQ.0)GO TO 125                                             ADLR321
     J4=J4+1                                                            ADLR322
     GO TO 117                                                          ADLR323
 116 DO 109 I=1,NX                                                      ADLR324
     E=EX(I)                                                            ADLR325
     JFLAGI=JFLAG(I)                                                    ADLR326
     CALL ADSIGMA(E,NIS,KK,IDPL)                                        ADLR327
     PRINT8,E,(AREF(LL),LL=1,3)                                         ADLR328
 109 CONTINUE                                                           ADLR329
     IF(IFLAG)1117,125,1117                                             ADLR330
1117 J4=J4+1                                                            ADLR331
     IF(NTOTAL-J4)125,1250,117                                          ADLR332
1250 E1=ERAN(1,J4)                                                      ADLR333
     G1=ERAN(2,J4)                                                      ADLR334
     GO TO 1116                                                         ADLR335
 125 CONTINUE                                                           ADLR336
 124 CONTINUE                                                           ADLR337
 130 CALL EXIT                                                          ADLR338
     END                                                                ADLR339
     SUBROUTINE ADSIGMA(Q,NIT,KK,IDPL)                                  ADSG001
     COMMON/D/ERAN(2,501)                                               ADSG002
     COMMON/C/EX(101),JFLAG(101)                                        ADSG003
     COMMON ARAY1(6,500),ARAY2(6,500),NOT(20),ZAI(20),ABN(10),          ADSG004
    1NER(10),LFW(10),EL(10,10),EH(10,10),LRU(10,10),LRF(10,10),         ADSG005
    2LANG(10,5,5),NLS(10,10),NRES(10),SPI(10),AP(10),LIS(10),AM(10),    ADSG006
    3AWRJ(10),LI(10),NXX(10),ABG(10,6,3),NJS(10,5,5),AJ(10,5,5),        ADSG007
    4AREF(6),TEFF,DELTA,E                                               ADSG008
     TEF=TEFF/293.0                                                     ADSG009
     E12=SQRT(Q)                                                        ADSG010
     T1=1.0/E12                                                         ADSG011
     N2=0                                                               ADSG012
     NTR=0                                                              ADSG013
     DO 4 J=1,6                                                         ADSG014
     AREF(J)=0.0                                                        ADSG015
   4 CONTINUE                                                           ADSG016
     DO 112 I=1,NIT                                                     ADSG017
     LT=1                                                               ADSG018
     LC=1                                                               ADSG019
     LF=1                                                               ADSG020
     LII=LI(I)                                                          ADSG021
     IF(LII-5)500,501,502                                               ADSG022
 500 PRINT1005                                                          ADSG023
1005 FORMAT(23H ERROR INPUT DATA LI(I))                                 ADSG024
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      GO TO 112                                                          ADSG025
  501 LF=0                                                               ADSG026
      GO TO 600                                                          ADSG027
  502 IF(LII-6)500,503,504                                               ADSG028
  503 LT=0                                                               ADSG029
      GO TO 600                                                          ADSG030
  504 IF(LII-7)500,505,500                                               ADSG031
  505 CONTINUE                                                           ADSG032
  600 NRESI=NRES(I)                                                      ADSG033
      API=AP(I)                                                          ADSG034
      AWRJI=AWRJ(I)                                                      ADSG035
      WN=2.196771E-03*(AWRJI/(AWRJI+1.0))*API                            ADSG036
      WAVE=2.196771E-03*(AWRJI/(AWRJI+1.0))                              ADSG037
      CC=1.0/(WAVE**2)                                                   ADSG038
      CC=CC*3.1415927                                                    ADSG039
      BELTA=0.3177*SQRT((TEF*Q)/AWRJI)                                   ADSG040
      IF(IDPL.EQ.0)GO TO 700                                             ADSG0401
      BETA=(CC*1.7724538)/BELTA                                          ADSG041
  700 XOMEGA=2.0*WN*E12                                                  ADSG042
      SIGT=0.0                                                           ADSG043
      SIGC=0.0                                                           ADSG044
      SIGF=0.0                                                           ADSG045
      NXXI=NXX(I)                                                        ADSG046
      IF(NXXI.EQ.2)GO TO 1000                                            ADSG047
      GO TO 1001                                                         ADSG0471
 1000 TAILT=ABG(I,1,1)+(ABG(I,2,1)/Q)+(ABG(I,3,1)/(Q**2))+               ADSG048
     1(ABG(I,4,1)/(Q**3))+ABG(I,5,1)*Q+ABG(I,6,1)*Q*Q                    ADSG049
       TAILT=TAILT*CC/E12                                                ADSG050
       TAILC=ABG(I,1,2)+(ABG(I,2,2)/Q)+(ABG(I,3,2)/(Q**2))+              ADSG051
     1(ABG(I,4,2)/(Q**3))+ABG(I,5,2)*Q+ABG(I,6,2)*Q*Q                    ADSG052
       TAILC=TAILC*CC/E12                                                ADSG053
       TAILF=0.0                                                         ADSG054
       GO TO 1010                                                        ADSG055
 1001 IF(NXXI.EQ.3)GO TO 1002                                            ADSG056
      GO TO 1003                                                         ADSG0561
 1002 TAILT=ABG(I,1,1)+(ABG(I,2,1)/Q)+(ABG(I,3,1)/(Q**2))+               ADSG057
     1(ABG(I,4,1)/(Q**3))+ABG(I,5,1)*Q+ABG(I,6,1)*Q*Q                    ADSG058
       TAILT=TAILT*CC/E12                                                ADSG059
       TAILF=ABG(I,1,2)+(ABG(I,2,2)/Q)+(ABG(I,3,2)/(Q**2))+              ADSG060
     1(ABG(I,4,2)/(Q**3))+ABG(I,5,2)*Q+ABG(I,6,2)*Q*Q                    ADSG061
       TAILF=TAILF*CC/E12                                                ADSG062
       TAILC=ABG(I,1,3)+(ABG(I,2,3)/Q)+(ABG(I,3,3)/(Q**2))+              ADSG063
     1(ABG(I,4,3)/(Q**3))+ABG(I,5,3)*Q+ABG(I,6,3)*Q*Q                    ADSG064
       TAILF=TAILF*CC/E12                                                ADSG065
       GO TO 1010                                                        ADSG066
 1003 PRINT1004                                                          ADSG067
 1004 FORMAT(24H ERROR INPUT DATA NXX(I))                                ADSG068
 1010 N1=N2+1                                                            ADSG069
      N2=N2+NRESI                                                        ADSG070
      DO 108 K=N1,N2                                                     ADSG071
      IF(LT.EQ.0)GO TO 300                                               ADSG072
      XMUT=ARAY1(1,K)                                                    ADSG073
      XNUT=ARAY1(2,K)                                                    ADSG074
      XGT=ARAY1(3,K)                                                     ADSG075
      XHT=ARAY1(4,K)                                                     ADSG076
      S1=XGT*COS(XOMEGA)+XHT*SIN(XOMEGA)                                 ADSG077
      S2=XHT*COS(XOMEGA)-XGT*SIN(XOMEGA)                                 ADSG078
      IF(IDPL.EQ.0)GO TO 201                                             ADSG079
      GO TO 202                                                          ADSG0791
  201 DEN=(XMUT+Q)**2+(XNUT**2)                                          ADSG080
      TERM=(XNUT*S1+(XMUT+Q)*S2)/DEN                                     ADSG081
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      SIGT=SIGT+(TERM*CC*T1)                                            ADSG082
      GO TO 300                                                         ADSG083
  202 SXI=(XMUT-Q)/BELTA                                                ADSG084
      ETA=XNUT/BELTA                                                    ADSG085
      CALL PFCN(SXI,ETA,U,V)                                            ADSG086
      TERM=T1*(S1*U+S2*V)                                               ADSG087
      SIGT=SIGT+TERM*BETA                                               ADSG088
  300 IF(LF.EQ.0)GO TO 400                                              ADSG089
      XMUF=ARAY1(5,K)                                                   ADSG090
      XNUF=ARAY1(6,K)                                                   ADSG091
      XGF=ARAY2(1,K)                                                    ADSG092
      XHF=ARAY2(2,K)                                                    ADSG093
      IF(IDPL.EQ.0)GO TO 301                                            ADSG094
      GO TO 302                                                         ADSG0941
  301 DEN=(XMUF-Q)**2+(XNUF**2)                                         ADSG095
      TERM=(XNUF*XGF+(XMUF-Q)*XHF)/DEN                                  ADSG096
      SIGF=SIGF+TERM*CC*T1                                              ADSG097
      GO TO 400                                                         ADSG098
  302 SXI=(XMUF-Q)/BELTA                                                ADSG099
      ETA=XNUF/BELTA                                                    ADSG100
      CALL PFCN(SXI,ETA,U,V)                                            ADSG101
      TERM=T1*(U*XGF+V*XHF)                                             ADSG102
      SIGF=SIGF+TERM*BETA                                               ADSG103
  400 IF(LC.EQ.0)GO TO 108                                              ADSG104
      XMUC=ARAY2(3,K)                                                   ADSG105
      XMUC=ARAY2(3,K)                                                   ADSG106
      XNUC=ARAY2(4,K)                                                   ADSG107
      XGC=ARAY2(5,K)                                                    ADSG108
      XHC=ARAY2(6,K)                                                    ADSG109
      IF(IDPL.EQ.0)GO TO 401                                            ADSG110
      GO TO 402                                                         ADSG1101
  401 DEN=(XMUC-Q)**2+(XNUC**2)                                         ADSG111
      TERM=(XNUC*XGC+(XMUC-Q)*XHC)/DEN                                  ADSG112
      SIGC=SIGC+TERM*CC*T1                                              ADSG113
      GO TO 108                                                         ADSG114
  402 SXI=(XMUC-E)/BELTA                                                ADSG115
      ETA=XNUC/BELTA                                                    ADSG116
      CALL PFCN(SXI,ETA,U,V)                                            ADSG117
      TERM=T1*(U*XGC+V*XHC)                                             ADSG118
      SIGC=SIGC+TERM*BETA                                               ADSG119
  108 CONTINUE                                                          ADSG120
      SIGP=(2.0/Q)*(1.0-COS(XOMEGA))*CC                                 ADSG121
      SIGT=SIGT+SIGP                                                    ADSG122
      SIGT=SIGT+TAILT                                                   ADSG123
      SIGF=SIGF+TAILF                                                   ADSG124
      SIGC=SIGC+TAILC                                                   ADSG125
      IF(LT.EQ.0)SIGT=0.0                                               ADSG126
      AREF(1)=AREF(1)+ABN(I)*SIGT                                       ADSG127
      AREF(2)=AREF(2)+ABN(I)*SIGF                                       ADSG128
      AREF(3)=AREF(3)+ABN(I)*SIGC                                       ADSG129
  112 CONTINUE                                                          ADSG130
      RETURN                                                            ADSG131
      END                                                               ADSG132
      SUBROUTINE SIEVE(E1,G1,E2,G2,M,N,NX,SEFF,BWR)                     SIEV001
      COMMON/C/EX(101),JFLAG(101)                                       SIEV002
      IF(E2.LT.E1)GO TO 101                                             SIEV003
      GO TO 300                                                         SIEV0031
  300 N2=2*N                                                            SIEV004
      DO 1000I=1,100                                                    SIEV005
      JFLAG(I)=2                                                        SIEV006
 1000 CONTINUE                                                          SIEV007
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      TEF=SEFF/293.0                                                    SIEV008
      DP=(1.5885E+00)*SQRT (TEF/BWR)                                    SIEV009
C     WHEN MULTIPLIED BY SQRT(E) DP GIVES 5 TIMES CORRESPONDING DELTA   SIEV010
      DP1=DP*SQRT(E1)                                                   SIEV011
      DP2=DP*SQRT (E2)                                                  SIEV012
      DG1=G1/FLOAT (M)                                                  SIEV013
      DG2=G2/FLOAT (M)                                                  SIEV014
      EX(1)=E1                                                          SIEV015
      IF(G1.LT.DP1)GO TO 1001                                           SIEV016
      GO TO 1002                                                        SIEV0161
 1001 JFLAG(1)=1                                                        SIEV017
 1002 ENDIF=ABS (E2-E1)                                                 SIEV018
      NX=1                                                              SIEV019
      DO 100 I=1,N                                                      SIEV020
      XX=E1+DG1*FLOAT (I)                                               SIEV021
      IF(XX.LT.E2)GO TO 107                                             SIEV022
      GO TO 100                                                         SIEV0221
  107 NX=NX+1                                                           SIEV023
      EX(NX)=XX                                                         SIEV024
      IF(G1.LT.DP1)GO TO 1003                                           SIEV025
      GO TO 100                                                         SIEV0251
 1003 JFLAG(NX)=1                                                       SIEV026
  100 CONTINUE                                                          SIEV027
      DO 200 I=1,N                                                      SIEV028
      XX=E2-DG2*FLOAT (I)                                               SIEV029
      IF(XX.GT.E1)GO TO 108                                             SIEV030
      GO TO 200                                                         SIEV0301
  108 NX=NX+1                                                           SIEV031
      EX(NX)=XX                                                         SIEV032
      IF(G2.LT.DP2)GO TO 1005                                           SIEV033
      GO TO 200                                                         SIEV0331
 1005 JFLAG(NX)=1                                                       SIEV034
  200 CONTINUE                                                          SIEV035
  110 DIFF=(E2-E1)/FLOAT (N2)                                           SIEV036
      IF(DIFF)101,101,102                                               SIEV037
  101 PRINT103                                                          SIEV038
      GO TO 104                                                         SIEV039
  103 FORMAT(32H CALLING SEQUENCE OF SIEVE WRONG)                       SIEV040
  102 N21=NX+1                                                          SIEV041
      NN=NX                                                             SIEV042
      N22=N21+N2-2                                                      SIEV043
      NX=N22                                                            SIEV044
      E21=(E1+E2)/2.0                                                   SIEV045
      DP12=DP*SQRT (E21)                                                SIEV046
      E43=E2-E1*((G1+G2)/2.0)                                           SIEV047
      IF(E43.LT.DP12)GO TO 1006                                         SIEV048
      GO TO 1007                                                        SIEV0481
 1006 DO 111 I=N21,N22                                                  SIEV049
      I2=I-NN                                                           SIEV050
      EX(I)=E1+DIFF*FLOAT (I2)                                          SIEV051
      JFLAG(I)=1                                                        SIEV052
  111 CONTINUE                                                          SIEV053
      GO TO 1040                                                        SIEV054
 1007 DO 112 I=N21,N22                                                  SIEV055
      I2=I-NN                                                           SIEV056
      EX(I)=E1+DIFF*FLOAT (I2)                                          SIEV057
      DPTEST=DP*SQRT (EX(I))                                            SIEV058
      IF(EX(I).LE.E21)GO TO 1008                                        SIEV059
      GO TO 1009                                                        SIEV0591
 1008 IF(G1.LT.DPTEST)GO TO 1010                                        SIEV060
      GO TO 112                                                         SIEV0601
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 1010 JFLAG(I)=1                                                        SIEV061
      GO TO 112                                                         SIEV062
 1009 IF(G2.LT.DPTEST)GO TO 1011                                        SIEV063
      GO TO 112                                                         SIEV0631
 1011 JFLAG(I)=1                                                        SIEV064
  112 CONTINUE                                                          SIEV065
 1040 DO 113 I=1,NX                                                     SIEV066
      DPF=DP*SQRT (EX(I))                                               SIEV067
      IF(DPF.EQ.0.0)GO TO 113                                           SIEV0671
      TERM=EX(I)/DPF                                                    SIEV068
      IF(TERM LT.5.0)GO TO 114                                          SIEV069
      GO TO 113                                                         SIEV0691
  114 JFLAG(I)=1                                                        SIEV070
  113 CONTINUE                                                          SIEV071
  104 RETURN                                                            SIEV072
      END                                                               SIEV073
      SUBROUTINE PFCN(SXI,ETA,U,V)                                      PFCN0001
CPFC2 SUBROUTINE TO EVALUATE THE COMPLEX PROBABILITY INTEGRAL           PFCN0002
C     AS A CONTOUR INTEGRAL                                             PFCN0003
      UREF(Z)=(H/PHI)*(Y1*EXP (-(Z**2))/((X1-Z)**2+Y1**2))              PFCN0005
      VIMF(Z)=(H/PHI)*((X1-Z)*EXP (-(Z**2))/((X1-Z)**2+Y1**2))          PFCN0006
      TANF(Z)=SIN(Z)/COS(Z)                                             PFCN0007
      VALF(Z)=(0.5641913939261 9+Z*(29.33733781 3464+Z*(563.226517080   PFCN0008
     1 14+Z*(5026.5043121835+Z*(21563.202428660+Z*(41170.756829233+     PFCN0009
     2Z*(27662.791034654+Z*(2810.061494 0005))))))))/(1.0+Z*(52.5       PFCN0010
     3+Z*(1023.75+Z*(9384.375+Z*(42229.6875+Z*(88682.34375              PFCN0011
     4+Z*(73901.953125+Z*(15836.1328125))))))))                         PFCN0012
      TERROR=1.0E-07                                                    PFCN0013
      PHI=3.1415926536                                                  PFCN0014
      X1=ABS(SXI)                                                       PFCN0015
      Y1=ABS(ETA)                                                       PFCN0016
      IF (X1) 11,22,11                                                  PFCN0017
   11 IF (Y1) 77,99,77                                                  PFCN0018
   99 IF (X1-2.0) 991,991,992                                           PFCN0019
  992 IF (X1-5.9) 9921,9922,9922                                        PFCN0020
 9922 I=0                                                               PFCN0021
      DWSN=0.0                                                          PFCN0022
      DW=1.0                                                            PFCN0023
  993 I=I+1                                                             PFCN0024
      GIG=I                                                             PFCN0025
      DW=DW*((2.0*GIG-1.0)/(2.0*(X1**2)))                               PFCN0026
      IF (DW-TERROR) 994,994,995                                        PFCN0027
  995 DWSN=DWSN+DW                                                      PFCN0028
      GO TO 993                                                         PFCN0029
  994 DWSN=DWSN+1.0                                                     PFCN0030
      DWSN=(DWSN)/(2.0*X1)                                              PFCN0031
      IF (SXI) 9941,9941,9942                                           PFCN0032
 9941 U=EXP (-(X1**2))                                                  PFCN0033
      V=((2.0)/SQRT (PHI))*DWSN                                         PFCN0034
      V=-V                                                              PFCN0035
      GO TO 88                                                          PFCN0036
 9942 U=EXP (-(X1**2))                                                  PFCN0037
      V=((2.0)/SQRT (PHI))*DWSN                                         PFCN0038
      GO TO 88                                                          PFCN0039
 9921 I=0                                                               PFCN0040
      DWSN=0.0                                                          PFCN0041
      AXE=(0.1)/(X1**2)                                                 PFCN0042
 9923 I=I+1                                                             PFCN0043
      GIG=I                                                             PFCN0044
      GIG=2.0*GIG-1.0                                                   PFCN0045
      GIG=GIG*GIG                                                       PFCN0046
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      TERM=(EXP (-(GIG*AXE*(X1**2))))/(GIG*AXE-1,0)                                    PFCN0047
      ABSTRM=ABS (TERM)                                                                PFCN0048
      IF (ABSTRM-TERROR) 9925,9925,9924                                                PFCN0049
 9924 DWSN=DWSN+TERM                                                                   PFCN0050
      GO TO 9923                                                                       PFCN0051
 9925 DWSN=(2.0)*SQRT (AXE/PHI)*DWSN                                                   PFCN0052
      DWSN1=(0,5)*SQRT (PHI)*EXP (-(X1**2))*TANF(PHI/(2,0*SQRT (AXE)))                 PFCN0053
      DWSN=-DWSN                                                                       PFCN0054
      DWSN=DWSN+DWSN1                                                                  PFCN0055
      IF (SXI) 9926,9926,9927                                                          PFCN0056
 9926 U=EXP (-(X1**2))                                                                 PFCN0057
      V=((2,0)/SQRT (PHI))*DWSN                                                        PFCN0058
      V=-V                                                                             PFCN0059
      GO TO 88                                                                         PFCN0060
 9927 U=EXP (-(X1**2))                                                                 PFCN0061
      V=((2,0)/SQRT (PHI))*DWSN                                                        PFCN0062
      GO TO 88                                                                         PFCN0063
  991 I=0                                                                              PFCN0064
      DWSN=0,0                                                                         PFCN0065
      DW=-(1,0)                                                                        PFCN0066
  996 I=I+1                                                                            PFCN0067
      GIG=I                                                                            PFCN0068
      DW=DW*((2,0*(X1**2))/(2,0*GIG-1,0))                                              PFCN0069
      DW=-DW                                                                           PFCN0070
      ABSDW=ABS (DW)                                                                   PFCN0071
      IF (ABSDW-TERROR) 997,997,998                                                    PFCN0072
  998 DWSN=DWSN+DW                                                                     PFCN0073
      GO TO 996                                                                        PFCN0074
  997 DWSN=DWSN/(2,0*X1)                                                               PFCN0075
      IF (SXI) 9971,9971,9972                                                          PFCN0076
 9971 U=EXP (-(X1**2))                                                                 PFCN0077
      V=((2.0)/SQRT (PHI))*DWSN                                                        PFCN0078
      V=-V                                                                             PFCN0079
      GO TO 88                                                                         PFCN0080
 9972 U=EXP (-(X1**2))                                                                 PFCN0081
      V=((2,0)/SQRT (PHI))*DWSN                                                        PFCN0082
      GO TO 88                                                                         PFCN0083
   22 IF (ETA) 44,55,66                                                                PFCN0084
   44 IF(Y1-1.5)444,445,445                                                            PFCN0085
  444 U=EXP (Y1**2)*(1,0+ERRORF(Y1))                                                   PFCN0086
      V=0.0                                                                            PFCN0087
      GO TO 88                                                                         PFCN0088
  445 X2=1,0/(Y1*Y1)                                                                   PFCN0089
      U=2.0*EXP (Y1**2)*(VALF(X2)/Y1)                                                  PFCN0090
      V=0.0                                                                            PFCN0091
      GO TO 88                                                                         PFCN0092
   55 U=1.0                                                                            PFCN0093
      V=0.0                                                                            PFCN0094
      GO TO 88                                                                         PFCN0095
   66 IF(Y1-1.5)664,665,665                                                            PFCN0096
  664 U=EXP (Y1**2)*(1,0-ERRORF(Y1))                                                   PFCN0097
      V=0.0                                                                            PFCN0098
      GO TO 88                                                                         PFCN0099
  665 X2=1,0/(Y1*Y1)                                                                   PFCN0100
      U=VALF(X2)/Y1                                                                    PFCN0101
      V=0,0                                                                            PFCN0102
      GO TO 88                                                                         PFCN0103
   77 IF(X1-0.04)770,770,771                                                           PFCN0104
  770 IF(Y1-0.04)772,772,771                                                           PFCN0105
  772 H=0.5                                                                            PFCN0106
      GO TO 773                                                                        PFCN0107
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 771 RHO=SQRT (X1**2+Y1**2)                                                    PFCN0108
     TERL=ALOG(TERROR)                                                         PFCN0109
     RHO1=PHI*PHI-Y1*Y1                                                        PFCN0110
     IF(RHO1-0.1)1011,1012,1012                                                PFCN0111
1011 RHO1=0.1                                                                  PFCN0112
1012 RHO1=ABS (RHO1)                                                           PFCN0113
     RHO2=ALOG((1.13*RHO)/RHO1)                                                PFCN0114
     H1=PHI/SQRT (RHO2-TERL)                                                   PFCN0115
     RHO3=(PHI/H1)**2-Y1*Y1                                                    PFCN0116
     IF(RHO3-0.1)1021,1022,1022                                                PFCN0117
1021 RHO3=0.1                                                                  PFCN0118
1022 RHO3=ABS (RHO3)                                                           PFCN0119
     RHO4=ALOG((1.13*RHO)/RHO3)                                                PFCN0120
     H=PHI/SQRT (RHO4-TERL)                                                    PFCN0121
 773 AL=-(2.0)*PHI*Y1/H                                                        PFCN0122
     BM=(2.0)*X1*Y1                                                            PFCN0123
     CN=(2.0)*PHI*X1/H                                                         PFCN0124
     T=0.0                                                                     PFCN0125
     AU=UREF(0.0)                                                              PFCN0126
     UPOS=0.0                                                                  PFCN0127
 123 T=T+H                                                                     PFCN0128
     UT=UREF(T)                                                                PFCN0129
     IF(UT-TERROR) 122,122,1231                                                PFCN0130
1231 UPOS=UPOS+UT                                                              PFCN0131
     GO TO 123                                                                 PFCN0132
 122 UNEG=0.0                                                                  PFCN0133
     S=0.0                                                                     PFCN0134
 125 S=S-H                                                                     PFCN0135
     US=UREF(S)                                                                PFCN0136
     IF(US-TERROR) 124,124,1241                                                PFCN0137
1241 UNEG=UNEG+US                                                              PFCN0138
     GO TO 125                                                                 PFCN0139
 124 AU=AU+UPOS+UNEG                                                           PFCN0140
     GO TO 126                                                                 PFCN0141
 126 VPOS=0.0                                                                  PFCN0142
     AV=VIMF(0.0)                                                              PFCN0143
     T=0.0                                                                     PFCN0144
 128 T=T+H                                                                     PFCN0145
     VT=VIMF(T)                                                                PFCN0146
     ABSPT=ABS (VT)                                                            PFCN0147
     IF (ABSPT-TERROR) 127,127,1271                                            PFCN0148
1271 VPOS=VPOS+VT                                                              PFCN0149
     GO TO 128                                                                 PFCN0150
 127 S=0.0                                                                     PFCN0151
     VNEG=0.0                                                                  PFCN0152
 130 S=S-H                                                                     PFCN0153
     VS=VIMF(S)                                                                PFCN0154
     ABSPS=ABS (VS)                                                            PFCN0155
     IF(ABSPS-TERROR) 129,129,1291                                             PFCN0156
1291 VNEG=VNEG+VS                                                              PFCN0157
     GO TO 130                                                                 PFCN0158
 129 AV=AV+VPOS+VNEG                                                           PFCN0159
     U1=AU                                                                     PFCN0160
     V1=AV                                                                     PFCN0161
     POLR=(2.0*EXP (Y1**2-X1**2)*(EXP (2,0*AL)*COS (BM)-EXP (AL)*              PFCN0162
    1COS (CN-BM)))/(1.0-2.0*EXP (AL)*COS (CN)*EXP (2.0*AL))                    PFCN0163
     POLI=-(2.0*EXP (Y1**2-X1**2)*(EXP (2.0*AL)*SIN (BM)*EXP (AL)*             PFCN0164
    1SIN (CN-BM)))/(1.0-2.0*EXP (AL)*COS (CN)*EXP (2.0*AL))                    PFCN0165
     PHIH=PHI/H                                                                PFCN0166
     IF(Y1-PHIH) 300,400,500                                                   PFCN0167
 300 A=1.0                                                                     PFCN0168
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      B=1,0                                                                    PFCN0169
      GO TO 600                                                                PFCN0170
  400 A=0,5                                                                    PFCN0171
      B=0,5                                                                    PFCN0172
      GO TO 600                                                                PFCN0173
  500 A=0,0                                                                    PFCN0174
      B=0,0                                                                    PFCN0175
  600 U1=U1+A*POLR                                                             PFCN0176
      V1=V1+B*POLI                                                             PFCN0177
      GO TO 33                                                                 PFCN0178
   33 IF (SXI) 331,88,333                                                      PFCN0179
  331 IF (ETA) 441,88,443                                                      PFCN0180
  333 IF (ETA) 661,88,663                                                      PFCN0181
  441 U=2,0*EXP (Y1**2-X1**2)*COS (2,0*X1*Y1)-U1                               PFCN0182
      V=-2,0*EXP (Y1**2-X1**2)*SIN (2,0*X1*Y1)-V1                              PFCN0183
      GO TO 88                                                                 PFCN0184
  443 U=U1                                                                     PFCN0185
      V=-V1                                                                    PFCN0186
      GO TO 88                                                                 PFCN0187
  661 U=2,0*EXP (Y1**2-X1**2)*COS (2,0*X1*Y1)-U1                               PFCN0188
      V=2,0*EXP (Y1**2-X1**2)*SIN (2,0*X1*Y1)+V1                               PFCN0189
      GO TO 88                                                                 PFCN0190
  663 U=U1                                                                     PFCN0191
      V=V1                                                                     PFCN0192
   88 RETURN                                                                   PFCN0193
      END                                                                      PFCN0194
      FUNCTION ERRORF(X)                                                       ERRF001
      DATA P,A1,A2,A3,A4,A5/0,3275911,0,254829592,-0,284496736,                ERRF002
     1 1,421413741,-1,453152027,1,061405429/                                   ERRF003
      T=1,0/(1,0+P*X)                                                          ERRF004
      ERRORF=1,0-((((A5*T+A4)*T+A3)*T+A2)*T+A1)*T*EXP(-X**2)                   ERRF005
      RETURN                                                                   ERRF006
      END                                                                      ERRF007
      SUBROUTINE MOV(I,J)                                                      MOV001
      COMMON/D/ERAN(2,501)                                                     MOV002
      I1=I                                                                     MOV003
      J1=J                                                                     MOV004
      IF(I1.EQ.0)I1=501                                                        MOV005
      IF(J1.EQ.0)J1=501                                                        MOV006
      ERAN(1,J1)=ERAN(1,I1)                                                    MOV007
      ERAN(2,J1)=ERAN(2,I1)                                                    MOV008
      RETURN                                                                   MOV009
      END                                                                      MOV010
      SUBROUTINE MOVE(I,J)                                                     MOVE001
      COMMON/C/EX(101),JFLAG(101)                                              MOVE002
      I1=I                                                                     MOVE003
      J1=J                                                                     MOVE004
      IF(I1.EQ.0)I1=101                                                        MOVE005
      IF(J1.EQ.0)J1=101                                                        MOVE006
      EX(J1)=EX(I1)                                                            MOVE007
      JFLAG(J1)=JFLAG(I1)                                                      MOVE008
      RETURN                                                                   MOVE009
      END                                                                      MOVE010
      FUNCTION KOM(I,J)                                                        KOM001
      COMMON/D/ERAN(2,501)                                                     KOM002
      I1=I                                                                     KOM003
      J1=J                                                                     KOM004
      IF(I1.EQ.0)I1=501                                                        KOM005
      IF(J1.EQ.0)J1=501                                                        KOM006
      EOM=ERAN(1,I1)-ERAN(1,J1)                                                KOM007
      IF(EOM)100,101,102                                                       KOM008
```

```
  100 KOM=-1                                                          KOM009
      GO TO 103                                                       KOM010
  101 KOM=0                                                           KOM011
      GO TO 103                                                       KOM012
  102 KOM=1                                                           KOM013
  103 RETURN                                                          KOM014
      END                                                             KOM015
      FUNCTION KOME(I,J)                                              KOME001
      COMMON/C/EX(101),JFLAG(101)                                     KOME002
      I1=I                                                            KOME003
      J1=J                                                            KOME004
      IF(I1.EQ.0)I1=101                                               KOME005
      IF(J1.EQ.0)J1=101                                               KOME006
      EOX=EX(I1)-EX(J1)                                               KOME007
      IF(EOX)100,101,102                                              KOME008
  100 KOME=-1                                                         KOME009
      GO TO 103                                                       KOME010
  101 KOME=0                                                          KOME011
      GO TO 103                                                       KOME012
  102 KOME=1                                                          KOME013
  103 RETURN                                                          KOME014
      END                                                             KOME015
      SUBROUTINE QIKS (MM,NN,MOVE,COMPAR)                             QIKS0010
CQIKS          ALL-IN-MEMORY SORT PROGRAM                           QIKS0020
C     MM = FIRST SUBSCRIPT                                          QIKS0030
C     NN = LAST SUBSCRIPT  (ARRAY IS IN COMMON)                     QIKS0040
C     MOVE AND COMPAR ARE USER SUPPLIED PROGRAMS                    QIKS0050
      DIMENSION MSAVE(20),NSAVE(20)                                   QIKS0060
      KEYLOC(M,N)=(N+M)/2                                             QIKS0070
      I=0                                                             QIKS0080
      J=0                                                             QIKS0090
      LEVEL  = 0                                                      QIKS0100
      M=MM                                                            QIKS0110
      N=NN                                                            QIKS0120
   35 CONTINUE                                                        QIKS0130
C     TEST FOR ONE OR TWO ITEMS                                       QIKS0140
      IF(N-M-1) 31,51,32                                              QIKS0150
C  32 CONTINUE                                                        QIKS0160
C     PARTITION AND SPREADER GO HERE, SEE BELOW,  RETURN IS TO 8      QIKS0170
C     PUSH DOWN                                                       QIKS0180
    8 LEVEL=LEVEL+1                                                   QIKS0190
C     WORK ON SMALLEST PORTION                                        QIKS0200
      IF ((J-M) - (N-I)) 134, 134, 34                                 QIKS0210
  134 MSAVE(LEVEL) = I                                                QIKS0220
      NSAVE(LEVEL)=N                                                  QIKS0230
      N=J                                                             QIKS0240
      GO TO 35                                                        QIKS0250
   34 MSAVE(LEVEL)=M                                                  QIKS0260
      NSAVE(LEVEL)=J                                                  QIKS0270
      M=I                                                             QIKS0280
      GO TO 35                                                        QIKS0290
   51 IF(COMPAR(M,N))31,31,131                                        QIKS0300
C     SWAP IF ONLY TWO ITEMS ARE OUT OF ORDER                         QIKS0310
  131 CALL MOVE(M,0)                                                  QIKS0320
      CALL MOVE(N,M)                                                  QIKS0330
      CALL MOVE(0,N)                                                  QIKS0340
   31 IF (LEVEL) 151, 150, 151                                        QIKS0350
  150 RETURN                                                          QIKS0360
C     POP UP                                                          QIKS0370
  151 M = MSAVE(LEVEL)                                                QIKS0380
      N=NSAVE(LEVEL)                                                  QIKS0390
```

```
      LEVEL=LEVEL-1                                                    QIKS0400
      GO TO 35                                                         QIKS0410
C     END   MAIN                                                       QIKS0420
C     PARTITION                                                        QIKS0430
   32 I=M                                                              QIKS0440
      J=N                                                              QIKS0450
      KEY=KEYLOC(M,N)                                                  QIKS0460
      CALL MOVE(KEY, 0)                                                QIKS0470
   54 IF (N - KEY) 17, 1, 17                                           QIKS0480
   17 CALL MOVE(N,KEY)                                                 QIKS0490
    1 CONTINUE                                                         QIKS0500
C     HOLE AT BOTTOM                                                   QIKS0510
      IF(COMPAR(0,I))3,2,2                                             QIKS0520
    2 I=I+1                                                            QIKS0530
      IF (I - J) 1, 4, 1                                               QIKS0540
    3 CALL MOVE(I,J)                                                   QIKS0550
      GO TO 5                                                          QIKS0560
    6 CONTINUE                                                         QIKS0570
C     HOLE AT TOP                                                      QIKS0580
      IF(COMPAR(0,J))5,5,7                                             QIKS0590
    5 J=J-1                                                            QIKS0600
      IF (I - J) 6, 4, 6                                               QIKS0610
    7 CALL MOVE(J,I)                                                   QIKS0620
      GO TO 2                                                          QIKS0630
C   4 CONTINUE                                                         QIKS0640
C     SPREADER GOES HERE                                               QIKS0650
C     END   PARTITION                                                  QIKS0660
C     SPREADER                                                         QIKS0670
    4 CALL MOVE(0,I)                                                   QIKS0680
   12 IF (I - N) 110, 10, 110                                          QIKS0690
  110 I = I + 1                                                        QIKS0700
      IF(COMPAR(0,I))10,12,10                                          QIKS0710
   10 IF (J - M) 108, 8, 108                                           QIKS0720
  108 J = J - 1                                                        QIKS0730
      IF(COMPAR(0,J))8,10,8                                            QIKS0740
C   8 CONTINUE                                                         QIKS0750
C     RETURN TO MAIN PROGRAM                                           QIKS0760
      END                                                              QIKS0770
```

```
ADLER TEST, U-233 DATA,                    0293.0
     92233,  231.0375                 0          0          1          0
     92233,       1.0                 0          1          1          0
      0.790      60.0                 1          4          0          0
        2.5   1.00925                 0          0          1          0
 231.0375           0.                 6          0         18          3
        0.0         0.0         0.0        0.0        0.0        0.0
        0.0         0.0         0.0        0.0        0.0        0.0
        0.0         0.0         0.0        0.0        0.0        0.0
        0.0         0.0           0          0          1          0
        2.5         0.0           0          0        876         73
 0.          0          0.          0.         -2.7900E+00 3.7000E-01
-2.5726E-03-8.2336E-04-2.7900E+00 3.7000E-01 1.6119E-04-6.8078E-06
 0.          0          0.          0.          1.8000E-01 7.0000E-02
-3.1983E-07-1.2945E-06 1.8000E-01 7.0000E-02 4.2644E-07-6.0920E-08
 0.          0          0.          0.          1.4200E+00 3.5000E-01
 9.8401E-05-5.1965E-05 1.4200E+00 3.5000E-01 3.5486E-06-1.1103E-05
 0.          0          0.          0.          1.7800E+00 1.2000E-01
 1.6998E-04-4.4167E-07 1.7800E+00 1.2000E-01 3.9887E-05 8.8334E-06
 0.          0          0.          0.          2.2900E+00 5.0000E-02
 6.5002E-05 2.6881E-05 2.2900E+00 5.0000E-02 5.6747E-05 2.8328E-06
 0.          0          0.          0.          3.3000E+00 5.0000E-01
 5.6869E-05-6.4606E-05 3.3000E+00 5.0000E-01 2.4520E-06 1.0661E-06
 0.          0          0.          0.          3.6300E+00 8.0000E-02
 3.1404E-05 1.0707E-05 3.6300E+00 8.0000E-02 1.4057E-05 1.3250E-06
 0.          0          0.          0.          4.5200E+00 3.9000E-01
 6.6570E-05-8.2684E-05 4.5200E+00 3.9000E-01 5.7874E-06-4.1730E-06
 0.          0          0.          0.          5.7300E+00 1.8000E-01
 1.5626E-05-3.8745E-05 5.7300E+00 1.8000E-01 5.1020E-06-3.2744E-06
 0.          0          0.          0.          6.8000E+00 9.0000E-02
 2.5643E-04 5.2802E-05 6.8000E+00 9.0000E-02 8.7314E-05 4.0359E-06
 0.          0          0.          0.          7.4900E+00 9.0000E-02
 7.9501E-06 2.1170E-06 7.4900E+00 9.0000E-02 2.6805E-06 1.5078E-06
 0.          0          0.          0.          8.6300E+00 2.6000E-01
 2.3332E-05-1.1118E-06 8.6300E+00 2.6000E-01 3.5029E-06-2.8328E-06
 0.          0          0.          0.          9.1500E+00 1.4000E-01
 2.2373E-05-2.3180E-05 9.1500E+00 1.4000E-01 4.8431E-06-9.4426E-07
 0.          0          0.          0.          1.0350E+01 1.6000E-01
 4.1572E-04 5.1934E-06 1.0350E+01 1.6000E-01 8.2866E-05 3.6095E-06
 0.          0          0.          0.          1.1280E+01 2.0000E-01
 5.2970E-05 1.4057E-05 1.1280E+01 2.0000E-01 5.4523E-06-5.0107E-06
 0.          0          0.          0.          1.1750E+01 1.6000E-01
 9.7624E-06-6.3204E-06 1.1750E+01 1.6000E-01-1.0493E-05-3.5029E-07
 0.          0          0.          0.          1.2760E+01 1.7000E-01
 3.5308E-04 6.7225E-05 1.2760E+01 1.7000E-01 4.8873E-05 3.5334E-06
 0.          0          0.          0.          1.3470E+01 2.0000E-01
 5.1934E-05 2.5495E-05 1.3470E+01 2.0000E-01 1.4910E-05-5.3610E-06
 0.          0          0.          0.          1.3660E+01 1.4000E-01
 7.4794E-05-3.2013E-05 1.3660E+01 1.4000E-01 3.1678E-06 2.3759E-06
 0.          0          0.          0.          1.5280E+01 1.2000E-01
 1.8151E-04-5.5650E-05 1.5280E+01 1.2000E-01 7.0576E-05-4.4167E-06
 0.          0          0.          0.          1.6130E+01 2.2000E-01
 1.5429E-04-7.5693E-06 1.6130E+01 2.2000E-01 8.2090E-06-4.5842E-06
 0.          0          0.          0.          1.6520E+01 1.3000E-01
 1.4357E-04 4.0527E-05 1.6520E+01 1.3000E-01 3.0475E-05 6.6250E-06
 0.          0          0.          0.          1.7930E+01 1.2000E-01
 6.4438E-05 6.3357E-06 1.7930E+01 1.2000E-01 1.4651E-05 2.1627E-06
 0.          0          0.          0.          1.8420E+01 2.1000E-01
 9.0755E-05 7.4627E-07 1.8420E+01 2.1000E-01 1.0006E-05-1.9190E-06
 0.          0          0.          0.          1.8860E+01 1.5000E-01
 3.2556E-04-6.9144E-05 1.8860E+01 1.5000E-01 5.3670E-05 4.6908E-06
```

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0.          0          0.          0.          2.0530E+01 2.0000E-01
1.6876E-04  1.0158E-05 2.0530E+01 2.0000E-01 2.8617E-05 1.2184E-06
0.          0          0.          0.          2.1850E+01 1.3000E-01
1.9918E-04  1.3316E-04 2.1850E+01 1.3000E-01 5.2391E-05 1.7316E-05
0.          0          0.          0.          2.2230E+01 2.4000E-01
8.1222E-04-1.2172E-04  2.2230E+01 2.4000E-01 9.8431E-05-1.2047E-05
0.          0          0.          0.          2.2940E+01 3.8000E-01
1.4414E-04  2.2236E-06 2.2940E+01 3.8000E-01-1.4179E-05-1.1895E-05
0.          0          0.          0.          2.3540E+01 3.3000E-01
9.8112E-05-1.4114E-04  2.3540E+01 3.3000E-01 6.1072E-06 4.6147E-06
0.          0          0.          0.          2.5130E+01 1.9000E-01
1.2617E-04-6.4088E-05  2.5130E+01 1.9000E-01 2.1109E-05-4.8736E-07
0.          0          0.          0.          2.6190E+01 1.7000E-01
4.8584E-06  1.5946E-05 2.6190E+01 1.7000E-01-8.6963E-06-2.1322E-06
0.          0          0.          0.          2.6570E+01 2.4000E-01
9.4563E-05  1.7773E-05 2.6570E+01 2.4000E-01 1.9631E-05 1.3783E-05
0.          0          0.          0.          2.7390E+01 4.3000E-01
2.0302E-05-1.6707E-05  2.7390E+01 4.3000E-01 1.1636E-05 5.3457E-06
0.          0          0.          0.          2.8330E+01 1.6000E-01
3.4603E-05  3.6933E-05 2.8330E+01 1.6000E-01 1.7758E-05-6.3966E-07
0.          0          0.          0.          2.8990E+01 3.0000E-01
3.1153E-04  8.7572E-06 2.8990E+01 3.0000E-01 2.6835E-05-1.1666E-05
0.          0          0.          0.          2.9660E+01 7.0000E-02
6.6860E-06  1.7469E-05 2.9660E+01 7.0000E-02 4.8584E-06-1.0052E-06
0.          0          0.          0.          3.0150E+01 1.0000E-01
4.0055E-06-2.8785E-06  3.0150E+01 1.0000E-01-9.5949E-07-1.9494E-06
0.          0          0.          0.          3.0760E+01 1.4000E-01
7.9394E-05  7.2205E-05 3.0760E+01 1.4000E-01 1.7910E-05 1.2945E-06
0.          0          0.          0.          3.1200E+01 4.7000E-01
2.1057E-04-1.1311E-04  3.1200E+01 4.7000E-01 1.8809E-05-8.7420E-06
0.          0          0.          0.          3.1980E+01 1.4000E-01
1.6314E-04  1.9007E-05 3.1980E+01 1.4000E-01 3.5227E-05-1.0265E-05
0.          0          0.          0.          3.2740E+01 4.3000E-01
6.1103E-05-1.4001E-04  3.2740E+01 4.3000E-01-1.3098E-06-1.6464E-05
0.          0          0.          0.          3.4030E+01 6.6000E-01
1.4634E-04  4.8660E-05 3.4030E+01 6.6000E-01-3.4648E-05-3.6994E-05
0.          0          0.          0.          3.4530E+01 4.2000E-01
2.6161E-04  4.9741E-05 3.4530E+01 4.2000E-01 6.2748E-06 2.2281E-05
0.          0          0.          0.          3.5190E+01 1.2000E-01
4.0420E-05-9.2446E-06  3.5190E+01 1.2000E-01-5.5589E-06 1.8885E-06
0.          0          0.          0.          3.5460E+01 1.7000E-01
1.7773E-05-3.5958E-05  3.5460E+01 1.7000E-01 1.7362E-06 9.4578E-06
0.          0          0.          0.          3.6540E+01 9.0000E-02
8.5593E-05  2.8130E-05 3.6540E+01 9.0000E-02 2.9988E-05 8.3613E-06
0.          0          0.          0.          3.7500E+01 2.4000E-01
1.1392E-04  4.5766E-05 3.7500E+01 2.4000E-01 7.9957E-06 4.7061E-06
0.          0          0.          0.          3.9460E+01 2.8000E-01
1.7370E-04  1.7536E-04 3.9460E+01 2.8000E-01-2.2083E-06-1.8733E-05
0.          0          0.          0.          3.9570E+01 1.6000E-01
2.9546E-06-9.8538E-05  3.9570E+01 1.6000E-01-6.4271E-06 1.3067E-05
0.          0          0.          0.          4.0060E+01 4.9000E-01
1.4452E-04-1.4173E-04  4.0060E+01 4.9000E-01 1.3052E-05 1.6677E-05
0.          0          0.          0.          4.1060E+01 9.0000E-02
3.1755E-05  2.0195E-05 4.1060E+01 9.0000E-02 1.6372E-05 4.9802E-06
0.          0          0.          0.          4.2620E+01 1.2000E-01
9.3923E-05  2.5434E-05 4.2620E+01 1.2000E-01 2.6424E-05 5.4371E-06
0.          0          0.          0.          4.3470E+01 1.4000E-01
5.0685E-05  8.5136E-06 4.3470E+01 1.4000E-01 1.0539E-05-1.6753E-07
0.          0          0.          0.          4.4640E+01 5.6000E-01
1.1797E-04  3.8715E-05 4.4640E+01 5.6000E-01 5.3305E-06 9.1228E-06
0.          0          0.          0.          4.5310E+01 5.2000E-01
```

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1.6966E-05-6.0691E-05 4.5310E+01 5.2000E-01 6.8383E-06-6.9601E-06
0.          0         0.          0.          4.6010E+01 8.0000E-02
3.8760E-05-2.4612E-05 4.6010E+01 8.0000E-02 2.1977E-05-6.2291E-06
0.          0         0.          0.          4.7170E+01 2.3000E-01
1.1409E-04-9.8081E-06 4.7170E+01 2.3000E-01 5.5894E-06-5.6656E-06
0.          0         0.          0.          4.8640E+01 1.3000E-01
2.5373E-04-3.2836E-05 4.8640E+01 1.3000E-01 1.2224E-04 5.0107E-06
0.          0         0.          0.          4.9120E+01 9.0000E-02
1.3753E-05-9.7320E-06 4.9120E+01 9.0000E-02-3.3049E-06-7.0819E-06
0.          0         0.          0.          5.0210E+01 4.5000E-01
7.7673E-05-4.5705E-05 5.0210E+01 4.5000E-01-2.5891E-07-6.1529E-06
0.          0         0.          0.          5.0990E+01 3.8000E-01
2.7277E-05-6.8535E-07 5.0990E+01 3.8000E-01-2.2845E-06-1.2489E-05
0.          0         0.          0.          5.1950E+01 6.2000E-01
2.3652E-05-6.6174E-05 5.1950E+01 6.2000E-01-2.4886E-05 1.0813E-06
0.          0         0.          0.          5.2910E+01 2.2000E-01
7.2875E-05-9.7700E-05 5.2910E+01 2.2000E-01 1.2397E-05 3.6704E-06
0.          0         0.          0.          5.3970E+01 1.4000E-01
9.1837E-05-3.4435E-05 5.3970E+01 1.4000E-01 1.7179E-05 3.4724E-06
0.          0         0.          0.          5.4770E+01 9.0000E-02
9.1928E-05 1.1362E-05 5.4770E+01 9.0000E-02 3.0780E-05 3.9141E-06
0.          0         0.          0.          5.6090E+01 2.7000E-01
9.3314E-05 1.9525E-04 5.6090E+01 2.7000E-01 8.8334E-06 3.8075E-07
0.          0         0.          0.          5.6350E+01 3.0000E-01
3.3395E-04-8.1937E-05 5.6350E+01 3.0000E-01 3.4344E-05 8.0414E-06
0.          0         0.          0.          5.7480E+01 4.9000E-01
4.3587E-04 3.5943E-05 5.7480E+01 4.9000E-01 2.4002E-05 4.8888E-06
0.          0         0.          0.          5.8510E+01 2.3000E-01
1.4106E-04 3.9598E-05 5.8510E+01 2.3000E-01 1.5763E-05-3.0765E-06
0.          0         0.          0.          6.1300E+01 4.0000E-01
2.8253E-04 7.2312E-05 6.1300E+01 4.0000E-01 1.2717E-05-1.7971E-06
0.          0         0.          0.          6.2500E+01 2.0000E-01
1.6427E-04-2.2784E-05 6.2500E+01 2.0000E-01 8.5410E-05-3.9903E-06
0.          0         0.          0.          6.4300E+01 4.0000E-01
3.4727E-04-3.3582E-05 6.4300E+01 4.0000E-01 5.4082E-05-2.4642E-05
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PROGRAM ADLER, CALCULATES CROSS-SECTIONS FROM ADLER-ADLER PARAMETERS WITH OPTION FOR DOPPLER BROADENING,

ENDF/B VERSION II DATA,

TITLE ADLER TEST, U-233 DATA,

OPTION TO DOPPLER BROADEN 0 EFFECTIVE TEMPERATURE(*K) 293,000

(Z,A) DESIGNATION OF THE ELEMENT 9,2233E+04 AT.WT/MASS OF NEUTRON 2,3104E+02 NO OF ISOTOPES 1

DATA FOR ISOTOPE NUMBER 1

(Z,A) DESIGNATION OF THE ISOTOPE 9,2233E+04 FRACTIONAL ABUNDANCE 1,0000E+00 NO OF ENERGY RANGES 1
LOWER LIMIT OF THE ENERGY RANGE(EV) 7,9000E-01 UPPER LIMIT(EV) 6,0000E+01 LRU= 1 LRF= 4
NUCLEAR SPIN 2,5000E+00 SCATTERING LENGTH 1,0092E+00 NO OF L-VALUES 1
MASS OF THIS ISOTOPE IN UNITS OF NEUTRON MASS 2,3104E+02
LI= 6 IF LI=5 TOTAL AND CAPTURE, LI=6 FISSION AND CAPTURE, AND LI=7 TOTAL CAPTURE AND FISSION CROSS-SECTIONS GIVEN
NX= 3 IF NX=2 TOTAL AND CAPTURE BCKGRND PARAMETERS GIVEN,IF NX=3 TOTAL,CAPTURE AND FISSION PARAMETERS GIVEN

BACKGROUND PARAMETERS FOR THE TOTAL CROSS-SECTION
A1= 0,000000E+00 A2= 0,000000E+00 A3= 0,000000E+00 A4= 0,000000E+00 B1= 0,000000E+00 B2= 0,000000E+00

BACKGROUND PARAMETERS FOR THE FISSION CROSS-SECTION
A1= 0,000000E+00 A2= 0,000000E+00 A3= 0,000000E+00 A4= 0,000000E+00 B1= 0,000000E+00 B2= 0,000000E+00

BACKGROUND PARAMETERS FOR THE CAPTURE CROSS-SECTION
A1= 0,000000E+00 A2= 0,000000E+00 A3= 0,000000E+00 A4= 0,000000E+00 B1= 0,000000E+00 B2= 0,000000E+00

ANGULAR MOMENTUM OF THE RESONANCES 0 NUMBER OF J-STATES 1

J-VALUE FOR THESE RESONANCES 2,50 NUMBER OF RESONANCES FOR THE ABOVE L-VALUE AND THIS J IS 73

ADLER-ADLER PARAMETERS FOR THIS ISOTOPE

MUT	NUT	GT	HT
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00

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0,000000E+00          0,000000E+00          0,000000E+00          0,000000E+00
0,000000E+00          0,000000E+00          0,000000E+00          0,000000E+00
0,000000E+00          0,000000E+00          0,000000E+00          0,000000E+00
0,000000E+00          0,000000E+00          0,000000E+00          0,000000E+00
0,000000E+00          0,000000E+00          0,000000E+00          0,000000E+00
0,000000E+00          0,000000E+00          0,000000E+00          0,000000E+00
0,000000E+00          0,000000E+00          0,000000E+00          0,000000E+00
0,000000E+00          0,000000E+00          0,000000E+00          0,000000E+00
0,000000E+00          0,000000E+00          0,000000E+00          0,000000E+00
0,000000E+00          0,000000E+00          0,000000E+00          0,000000E+00
0,000000E+00          0,000000E+00          0,000000E+00          0,000000E+00
0,000000E+00          0,000000E+00          0,000000E+00          0,000000E+00
0,000000E+00          0,000000E+00          0,000000E+00          0,000000E+00
0,000000E+00          0,000000E+00          0,000000E+00          0,000000E+00
0,000000E+00          0,000000E+00          0,000000E+00          0,000000E+00


    MUF                   NUF                   GF                    HF
 -2,790000E+00          3,700000E-01         -2,572600E-03         -8,233600E-04
1,800000E-01          7,000000E-02         -3,198300E-07         -1,294500E-06
1,420000E+00          3,500000E-01          9,840100E-05         -5,196500E-05
1,780000E+00          1,200000E-01          1,699800E-04         -4,416700E-07
2,290000E+00          5,000000E-02          6,500200E-05          2,688100E-05
3,300000E+00          5,000000E-01          5,686900E-05         -6,460600E-05
3,630000E+00          8,000000E-02          3,140400E-05          1,070700E-05
4,520000E+00          3,900000E-01          6,657000E-05         -8,268400E-05
5,730000E+00          1,800000E-01          1,562600E-05         -3,874500E-05
6,800000E+00          9,000000E-02          2,564300E-04          5,280200E-05
7,490000E+00          9,000000E-02          7,950100E-06          2,117000E-06
8,630000E+00          2,600000E-01          2,333200E-05         -1,111800E-06
9,150000E+00          1,400000E-01          2,237300E-05         -2,318000E-05
1,035000E+01          1,600000E-01          4,157200E-04          5,193400E-06
1,128000E+01          2,000000E-01          5,297000E-05          1,405700E-05
1,175000E+01          1,600000E-01          9,762400E-06         -6,320400E-06
1,276000E+01          1,700000E-01          3,530800E-04          6,722500E-05
1,347000E+01          2,000000E-01          5,193400E-05          2,549500E-05
1,366000E+01          1,400000E-01          7,479400E-05         -3,201300E-05
1,528000E+01          1,200000E-01          1,815100E-04         -5,565000E-05
1,613000E+01          2,200000E-01          1,542900E-04         -7,569300E-06
1,652000E+01          1,300000E-01          1,435700E-04          4,052700E-05
1,793000E+01          1,200000E-01          6,443800E-05          6,335700E-06
1,842000E+01          2,100000E-01          9,075500E-05          7,462700E-07
1,886000E+01          1,500000E-01          3,255600E-04         -6,914400E-05
2,053000E+01          2,000000E-01          1,687600E-04          1,015800E-05
2,185000E+01          1,300000E-01          1,991800E-04          1,331600E-04
2,223000E+01          2,400000E-01          8,122200E-04         -1,217200E-04
2,294000E+01          3,820000E-01          1,441400E-04          2,223600E-06
2,354000E+01          3,300000E-01          9,811200E-05         -1,411400E-04
2,513000E+01          1,920000E-01          1,261700E-04         -6,408800E-05
2,619000E+01          1,700000E-01          4,858400E-06          1,594600E-05
2,657000E+01          2,400000E-01          9,456300E-05          1,777300E-05
2,739000E+01          4,300000E-01          2,030200E-05         -1,670700E-05
2,833000E+01          1,600000E-01          3,460300E-05          3,693300E-05
2,899000E+01          3,000000E-01          3,115300E-04          8,757200E-06
2,966000E+01          7,000000E-02          6,686000E-06          1,746900E-05
3,015000E+01          1,000000E-01          4,005500E-06         -2,878500E-06
3,076000E+01          1,400000E-01          7,939400E-05          7,220500E-05
3,120000E+01          4,700000E-01          2,105700E-04         -1,131100E-04
3,198000E+01          1,400000E-01          1,631400E-04          1,900700E-05
3,274000E+01          4,300000E-01          6,110300E-05         -1,400100E-04
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3,403000E+01	6,600000E-01	1,463400E-04	4,866000E-05
3,453000E+01	4,200000E-01	2,616100E-04	4,974100E-05
3,519000E+01	1,200000E-01	4,042000E-05	-9,244600E-06
3,546000E+01	1,700000E-01	1,777300E-05	-3,595800E-05
3,654000E+01	9,000000E-02	8,559300E-05	2,813000E-05
3,750000E+01	2,400000E-01	1,139200E-04	4,576600E-05
3,946000E+01	2,800000E-01	1,737000E-04	1,753600E-04
3,957000E+01	1,600000E-01	2,954600E-06	-9,853800E-05
4,006000E+01	4,900000E-01	1,445200E-04	-1,417300E-04
4,106000E+01	9,000000E-02	3,175500E-05	2,019500E-05
4,262000E+01	1,200000E-01	9,392300E-05	2,543400E-05
4,347000E+01	1,400000E-01	5,068500E-05	8,513600E-06
4,464000E+01	5,600000E-01	1,179700E-04	3,871500E-05
4,531000E+01	5,200000E-01	1,696600E-05	-6,069100E-05
4,601000E+01	8,000000E-02	3,876000E-05	-2,461200E-05
4,717000E+01	2,300000E-01	1,140900E-04	-9,808100E-06
4,864000E+01	1,300000E-01	2,537300E-04	-3,283600E-05
4,912000E+01	9,000000E-02	1,375300E-05	-9,732000E-06
5,021000E+01	4,500000E-01	7,767300E-05	-4,570500E-05
5,099000E+01	3,800000E-01	2,727700E-05	-6,853500E-07
5,195000E+01	6,200000E-01	2,365200E-05	-6,617400E-05
5,291000E+01	2,200000E-01	7,287500E-05	-9,770000E-05
5,397000E+01	1,400000E-01	9,183700E-05	-3,443500E-05
5,477000E+01	9,000000E-02	9,192800E-05	1,136200E-05
5,609000E+01	2,700000E-01	9,331400E-05	1,952500E-04
5,635000E+01	3,000000E-01	3,339500E-04	-8,193700E-05
5,748000E+01	4,900000E-01	4,358700E-04	3,594300E-05
5,851000E+01	2,300000E-01	1,410600E-04	3,959800E-05
6,130000E+01	4,000000E-01	2,825300E-04	7,231200E-05
6,250000E+01	2,000000E-01	1,642700E-04	-2,278400E-05
6,430000E+01	4,000000E-01	3,472700E-04	-3,358200E-05

MUC	NUC	GC	HC
-2,790000E+00	3,700000E-01	1,611900E-04	-6,807800E-06
1,800000E-01	7,000000E-02	4,264400E-07	-6,092000E-08
1,420000E+00	3,500000E-01	3,548600E-06	-1,110300E-05
1,780000E+00	1,200000E-01	3,988700E-05	8,833400E-06
2,290000E+00	5,000000E-02	5,674700E-05	2,832800E-06
3,300000E+00	5,000000E-01	2,452000E-06	1,066100E-06
3,630000E+00	8,000000E-02	1,405700E-05	1,325000E-06
4,520000E+00	3,900000E-01	5,787400E-06	-4,173000E-06
5,730000E+00	1,800000E-01	5,102000E-06	-3,274400E-06
6,800000E+00	9,000000E-02	8,731400E-05	4,035900E-06
7,490000E+00	9,000000E-02	2,680500E-06	1,507800E-06
8,630000E+00	2,600000E-01	3,502900E-06	-2,832800E-06
9,150000E+00	1,400000E-01	4,843100E-06	-9,442600E-07
1,035000E+01	1,600000E-01	8,286600E-05	3,609500E-06
1,128000E+01	2,000000E-01	5,452300E-06	-5,010700E-06
1,175000E+01	1,600000E-01	-1,049300E-05	-3,502900E-07
1,276000E+01	1,700000E-01	4,887300E-05	3,533400E-06
1,347000E+01	2,000000E-01	1,491000E-05	-5,361000E-06
1,366000E+01	1,400000E-01	3,167800E-06	2,375900E-06
1,528000E+01	1,200000E-01	7,057600E-05	-4,416700E-06
1,613000E+01	2,200000E-01	8,209000E-06	-4,584200E-06
1,652000E+01	1,300000E-01	3,047500E-05	6,625000E-06
1,793000E+01	1,200000E-01	1,465100E-05	2,162700E-06
1,842000E+01	2,100000E-01	1,000600E-05	-1,919000E-06
1,886000E+01	1,500000E-01	5,367000E-05	4,690800E-06
2,053000E+01	2,000000E-01	2,861700E-05	1,218400E-06

2,185000E+01	1,300000E-01	5,239100E-05	1,731600E-05
2,223000E+01	2,400000E-01	9,843100E-05	-1,204700E-05
2,294000E+01	3,800000E-01	-1,417900E-05	-1,189500E-05
2,354000E+01	3,300000E-01	6,107200E-06	4,614700E-06
2,513000E+01	1,900000E-01	2,110900E-05	-4,873600E-07
2,619000E+01	1,700000E-01	-8,696300E-06	-2,132200E-06
2,657000E+01	2,400000E-01	1,963100E-05	1,378300E-05
2,739000E+01	4,300000E-01	1,163600E-05	5,345700E-06
2,833000E+01	1,600000E-01	1,775800E-05	-6,396600E-07
2,899000E+01	3,000000E-01	2,683500E-05	-1,166600E-05
2,966000E+01	7,000000E-02	4,858400E-06	-1,005200E-06
3,015000E+01	1,000000E-01	-9,594900E-07	-1,949400E-06
3,076000E+01	1,400000E-01	1,791000E-05	1,294500E-06
3,120000E+01	4,700000E-01	1,880900E-05	-8,742000E-06
3,198000E+01	1,400000E-01	3,522700E-05	-1,026500E-05
3,274000E+01	4,300000E-01	-1,309800E-06	-1,646400E-05
3,403000E+01	6,600000E-01	-3,464800E-05	-3,699400E-05
3,453000E+01	4,200000E-01	6,274800E-06	2,228100E-05
3,519000E+01	1,200000E-01	-5,558900E-06	1,888500E-06
3,546000E+01	1,700000E-01	1,736200E-06	9,457800E-06
3,654000E+01	9,000000E-02	2,998800E-05	8,361300E-06
3,750000E+01	2,400000E-01	7,995700E-06	4,706100E-06
3,946000E+01	2,800000E-01	-2,208300E-06	-1,873300E-05
3,957000E+01	1,600000E-01	-6,427100E-06	1,306700E-05
4,006000E+01	4,900000E-01	1,305200E-05	1,667700E-05
4,106000E+01	9,000000E-02	1,637200E-05	4,980200E-06
4,262000E+01	1,200000E-01	2,642400E-05	5,437100E-06
4,347000E+01	1,400000E-01	1,053900E-05	-1,675300E-07
4,464000E+01	5,600000E-01	5,330500E-06	9,122800E-06
4,531000E+01	5,200000E-01	6,838300E-06	-6,960100E-06
4,601000E+01	8,000000E-02	2,197700E-05	-6,229100E-06
4,717000E+01	2,300000E-01	5,589400E-06	-5,665600E-06
4,864000E+01	1,300000E-01	1,222400E-04	5,010700E-06
4,912000E+01	9,000000E-02	-3,304900E-06	-7,081900E-06
5,021000E+01	4,500000E-01	-2,589100E-07	-6,152900E-06
5,099000E+01	3,800000E-01	-2,284500E-06	-1,248900E-05
5,195000E+01	6,200000E-01	-2,488600E-05	1,081300E-06
5,291000E+01	2,200000E-01	1,239700E-05	3,670400E-06
5,397000E+01	1,400000E-01	1,717900E-05	3,472400E-06
5,477000E+01	9,000000E-02	3,078000E-05	3,914100E-06
5,609000E+01	2,700000E-01	8,833400E-06	3,807500E-07
5,635000E+01	3,000000E-01	3,434400E-05	8,041400E-06
5,748000E+01	4,900000E-01	2,400200E-05	4,888800E-06
5,851000E+01	2,300000E-01	1,576300E-05	-3,076500E-06
6,130000E+01	4,000000E-01	1,271700E-05	-1,797100E-06
6,250000E+01	2,000000E-01	8,541000E-05	-3,990300E-06
6,430000E+01	4,000000E-01	5,408200E-05	-2,464200E-05

ADLER-ADLER CROSS-SECTIONS FOR THIS ELEMENT

CROSS-SECTIONS AT THERMAL ENERGY

NEUTRON ENERGY(EV)	TOTAL X-SECTION	FISSION X-SECTION	CAPTURE X-SECTION

2,530000E-02	0,000000E+00	5,212307E+02	4,774971E+01

CROSS-SECTIONS NOT DOPPLER BROADENED

NEUTRON ENERGY(EV)	TOTAL X-SECTION	FISSION X-SECTION	CAPTURE X-SECTION
7,900000E-01	0,000000E+00	1,161008E+02	9,006454E+00
8,530000E-01	0,000000E+00	1,185189E+02	9,343464E+00
8,600000E-01	0,000000E+00	1,189266E+02	9,395523E+00
9,160000E-01	0,000000E+00	1,233242E+02	9,936258E+00
9,300000E-01	0,000000E+00	1,247669E+02	1,011010E+01
9,790000E-01	0,000000E+00	1,310541E+02	1,086522E+01
1,000000E+00	0,000000E+00	1,343985E+02	1,126910E+01
1,042000E+00	0,000000E+00	1,424159E+02	1,225153E+01
1,070000E+00	0,000000E+00	1,488460E+02	1,305792E+01
1,070000E+00	0,000000E+00	1,488460E+02	1,305792E+01
1,105000E+00	0,000000E+00	1,582335E+02	1,426979E+01
1,140000E+00	0,000000E+00	1,692363E+02	1,574855E+01
1,140000E+00	0,000000E+00	1,692363E+02	1,574855E+01
1,168000E+00	0,000000E+00	1,792582E+02	1,715593E+01
1,210000E+00	0,000000E+00	1,963328E+02	1,970238E+01
1,231000E+00	0,000000E+00	2,057450E+02	2,119558E+01
1,280000E+00	0,000000E+00	2,296199E+02	2,532049E+01
1,294000E+00	0,000000E+00	2,368252E+02	2,667538E+01
1,350000E+00	0,000000E+00	2,664782E+02	3,293553E+01
1,357000E+00	0,000000E+00	2,702130E+02	3,381631E+01
1,420000E+00	0,000000E+00	3,034496E+02	4,281927E+01
1,456000E+00	0,000000E+00	3,224419E+02	4,897963E+01
1,490000E+00	0,000000E+00	3,415267E+02	5,572214E+01
1,492000E+00	0,000000E+00	3,427206E+02	5,615359E+01
1,528000E+00	0,000000E+00	3,665928E+02	6,477248E+01
1,560000E+00	0,000000E+00	3,937754E+02	7,419964E+01
1,564000E+00	0,000000E+00	3,977481E+02	7,552899E+01
1,600000E+00	0,000000E+00	4,415726E+02	8,943715E+01
1,630000E+00	0,000000E+00	4,929178E+02	1,043572E+02
1,636000E+00	0,000000E+00	5,052494E+02	1,077749E+02
1,660000E+00	0,000000E+00	5,625275E+02	1,229980E+02
1,672000E+00	0,000000E+00	5,961533E+02	1,315074E+02
1,684000E+00	0,000000E+00	6,329760E+02	1,405066E+02
1,700000E+00	0,000000E+00	6,861321E+02	1,529312E+02
1,708000E+00	0,000000E+00	7,137733E+02	1,591180E+02
1,708000E+00	0,000000E+00	7,137733E+02	1,591180E+02
1,732000E+00	0,000000E+00	7,945725E+02	1,758568E+02
1,744000E+00	0,000000E+00	8,290315E+02	1,820382E+02
1,756000E+00	0,000000E+00	8,654532E+02	1,858469E+02
1,770000E+00	0,000000E+00	8,722724E+02	1,865439E+02
1,780000E+00	0,000000E+00	8,733790E+02	1,843268E+02
1,804000E+00	0,000000E+00	8,381879E+02	1,703944E+02
1,828000E+00	0,000000E+00	7,618652E+02	1,483086E+02
1,831000E+00	0,000000E+00	7,506169E+02	1,452918E+02
1,852000E+00	0,000000E+00	6,682678E+02	1,242388E+02
1,876000E+00	0,000000E+00	5,771687E+02	1,025709E+02
1,882000E+00	0,000000E+00	5,561347E+02	9,778110E+01
1,900000E+00	0,000000E+00	4,984142E+02	8,505967E+01

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C      PROGRAM AVRAGE3(INPUT,OUTPUT)                                    AVG3001
C-----THIS PROGRAM CALCULATES AVERAGE CAPTURE AND FISSION CROSS-SECNS    AVG3002
C-----FROM ENDF/B DATA, LIMITATIONS=1,CALCULATES S AND P-WAVE X-SECNS    AVG3003
C-----ONLY,2,INELASTIC EFFECTS NOT ALLOWED FOR, 3,WIDTH FLUCTUATIONS OF  AVG3004
C-----=UPTO 4 DEGREES OF FREEDOM CAN BE AVERAGED OVER,                   AVG3005
C-----THIS PROGRAM MODIFIED ON 21,9,70 TO TAKE INTO ACCOUNT THE NEW      AVG3006
C-----FORMAT MODIFICATIONS WHICH GIVE THE ISOTOPE MASS AWRI AND THE NEW  AVG3007
C----=RECOMMENDATION TO USE THE RADIUS A=(1.23*AWRI**(1/3)+0.8)*0.1      AVG3008
C-----TO CALCULATE PENETRABILITIES AND USE A DIFFERENT RADIUS TO OBTAIN  AVG3009
C-----POTENTIAL SCATTERING, RUNS ON CDC-6600 AND PDP-10.                 AVG3010
      DIMENSION RUN(7),BLA(20),ES(100),MUFA(10),DA(10),XJA(10),XXJA(10),AVG3011
     1GNO(10),GG(10),GFE(100,10),MUFB(10),DAB(10),XJB(10),XXJB(10),     AVG3012
     2GNOB(10),GGB(10),GFEB(100,10),MUFF(10),MXJA(10),                  AVG3013
     3GIGGS(100),GIGGP(100),GIGFS(100),GIGFP(100),GISS(100),GISP(100)    AVG3014
      COMMON/XBAR/XX(4,10)                                               AVG3015
      DATA XX/0.005252,0.051755,0.112925,0.169150,0.037171,0.163095,     AVG3016
     10.265600,0.340780,0.103126,0.288421,0.404385,0.480571,0.207836,    AVG3017
     20.431766,0.547724,0.617825,0.359852,0.599210,0.704048,0.762381,    AVG3018
     30.574283,0.800560,0.882440,0.922898,0.879334,1.053224,1.096835,    AVG3019
     41.111387,1.334810,1.393010,1.374373,1.350285,2.105227,1.916230,    AVG3020
     51.786357,1.697511,4.390800,3.301643,2.824583,2.546602/             AVG3021
C-----11111111111111111111111111111111111111111111111111111111111111AVG3022
  881                 READ1,IRUN,(RUN(I),I=1,7),E0,EN,ESTEP              AVG3023
      IF(IRUN.EQ.0)GO TO 8800                                            AVG3024
      GO TO 882                                                          AVG30241
  882                 PRINT39                                            AVG3025
                      PRINT35                                            AVG3026
                      PRINT40                                            AVG3027
                      PRINT35                                            AVG3028
                      PRINT27,IRUN,(RUN(I),I=1,7),E0,EN,ESTEP            AVG3029
C-----IF IRUN EQUALS ZERO THE PROGRAM EXITS, RUN(1) TO RUN(7) ANY TITLE  AVG3030
C-----IN COLUMNS 11 TO 38, E0,EN,ESTEP ALL IN EV NEED BE GIVEN ONLY FOR  AVG3031
C----=A NON=FISSILE NUCLEUS, THE PROGRAM THEN CALCULATES THE AVERAGE     AVG3032
C----=CROSS-SECTIONS FROM E0 TO EN IN STEPS OF ESTEP, FOR A FISSILE NUCLAVG3033
C-----THE CROSS-SECTIONS ARE CALCULATED FOR THOSE ENERGIES ES(I) FOR WHIAVG3034
C----=-THE FISSION WIDTHS ARE GIVEN,EXCEPT FOR THE TITLE CARD ALL THE    AVG3035
C-----REST OF THE DATA CARDS ARE IN ENDF/B FORMAT FOR UNRESOLVED PARA=   AVG3036
C-----METERS IN FILE 2,                                                  AVG3037
    1 FORMAT(I10,7A4,2X,3E10.4)                                          AVG3038
                      NFLAG1=1                                           AVG3039
C-----=2222222222222222222222222222222222222222222222222222222222222222AVG3040
                      READ 2,EN1,EN2,LRU,LRF,LFI                         AVG3041
                     PRINT26,EN1,EN2,LRU,LRF,LFI                         AVG3042
C-----=EN1=LOWER ENERGY LIMIT OF A RANGE,EN2=UPPER LIMIT, LRU=1 IMPLIES  AVG3043
C-----=RESOLVED PARAMETERS,LRU=2 UNRESOLVED PARAMETERS, LFI=0 NON-FISSILEAVG3044
C-----ISOTOPE,LFI=1 FISSILE ISOTOPE,                                     AVG3045
    2 FORMAT(2E11.4,4I11)                                                AVG3046
C-----3333333333333333333333333333333333333333333333333333333333333333AVG3047
                      READ2,SPIN,A,BLA(2),BLA(3),NE,NLS                  AVG3048
                      PRINT28,SPIN,A,NE                                  AVG3049
C-----SPIN=NUCLEAR SPIN, A=SCATTERING LENGTH IN UNITS OF 1.0*E-12 CM,    AVG3050
C-----NE=NUMBER OF ENERGY VALUES AT WHICH FISSION WIDTHS ARE TABULATED,  AVG3051
C-----NLS=NUMBER OF L STATES,                                            AVG3052
C      IF NLS IS ZERO IT IS A NONFISSILE NUCLEUS, THIS IS DONE TO GET    AVG3053
C-----AROUND THE FACT THAT LFI IS GIVEN ONLY IN FILE1 FIRST SECTION      AVG3054
C-----AND NOWHERE IN FILE 2                                              AVG3055
      IF(NLS)640,640,641                                                 AVG3056
  641 PRINT23                                                            AVG3057
      PRINT35                                                            AVG3058
      PRINT24                                                            AVG3059
      PRINT35                                                            AVG3060
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C-----4444444444444444444444444444444444444444444444444444444444444444AVG3061
                    READ3,(ES(I),I=1,NE)                                AVG3062
      PRINT29                                                           AVG3063
                   PRINT3,(ES(I),I=1,NE)                                AVG3064
C-----ES(I)=ENERGY VALUES AT WHICH FISSION WIDTHS ARE TABULATED.        AVG3065
    3 FORMAT(6E11.4)                                                    AVG3066
C-----5555555555555555555555555555555555555555555555555555555555555555AVG3067
                  READ2,AWRI,BLA(5),LA,BLA(6),NJS,JA                    AVG3068
                  PRINT34,AWRI,LA,NJS                                   AVG3069
C-----THESE ARE S-WAVE PARAMETERS.                                      AVG3070
C-----AWRI=ISOTOPIC MASS IN UNITS OF THE NEUTRON MASS,LA=ANGULAR MOMENTMAVG3071
C-----NJS=NO OF SPIN STATES FOR THIS L-VALUE,JA=NJS FOR NON-FISSILE NUC.AVG3072
      JA=NJS                                                            AVG3073
      NR=NLS                                                            AVG3074
C-----6666666666666666666666666666666666666666666666666666666666666666AVG3075
      DO 644 I=1,JA                                                     AVG3076
                    READ2,BLA(7),BLA(8),LA,MUFA(I),BLA(9),BLA(10)       AVG3077
                    READ3,DA(I),XJA(I),XXJA(I),GNO(I),GG(I),DRAT        AVG3078
      PRINT35                                                           AVG3079
                    PRINT30,DA(I),XJA(I),GNO(I),GG(I)                   AVG3080
                    ILLIAD=INT(XXJA(I))                                 AVG3081
                    PRINT31,ILLIAD                                      AVG3082
                    PRINT32,MUFA(I)                                     AVG3083
      PRINT33                                                           AVG3084
                    READ3,(GFE(II,I),II=1,NE)                           AVG3085
                   PRINT3,(GFE(II,I),II=1,NE)                           AVG3086
  644 CONTINUE                                                          AVG3087
C-----THESE ARE S-WAVE PARAMETERS FOR A FISSILE NUCLEUS.                AVG3088
C-----LA=ANGULAR MOMENTUM,MUFA(I)=NUMBER OF DEGREES OF FREEDOM FOR FISSNAVG3089
C-----WIDTH DISTRIBUTION FOR THE I-TH SPIN STATE.                       AVG3090
C-----DA(I)=MEAN LEVEL SPACING I-TH SPIN STATE,XJA(I)=FLOATING PT VALUE AVG3091
C-----OF J, XXJA(I)=NUMBER OF DEGREES OF FREEDOM FOR NEUTRON WIDTH DSTRNAVG3092
C-----GNO(I)=AVERAGE REDUCED NEUTRON WIDTH(EV),GG(I)=AVERAGE GAMMA WDTH,AVG3093
C-----GFE(II,I)=AVERAGE FISSION WIDTH FOR I-TH SPIN STATE AND II-TH ENERAVG3094
C-----GY WHERE II RUNS FROM 1 TO NE.                                    AVG3095
      IF(NR-2)2085,95,88                                                AVG3096
  640 NFLAG1=0                                                          AVG3097
      PRINT22                                                           AVG3098
      PRINT35                                                           AVG3099
      PRINT24                                                           AVG3100
      PRINT35                                                           AVG3101
C     FROM NOW ON NFLAG1 ZERO INDICATES A NONFISSILE NUCLEUS            AVG3102
      NLS=NE                                                            AVG3103
      NR=NLS                                                            AVG3104
C-----7777777777777777777777777777777777777777777777777777777777777777AVG3105
                  READ2,AWRI,BLA(5),LA,BLA(6),NJS,JA                    AVG3106
                  PRINT34,AWRI,LA,JA                                    AVG3107
        DO 6400 I=1,JA                                                  AVG3108
                    READ3,DA(I),XJA(I),XXJA(I),GNO(I),GG(I),DRAT        AVG3109
                    PRINT30,DA(I),XJA(I),GNO(I),GG(I)                   AVG3110
                    ILLIAD=INT(XXJA(I))                                 AVG3111
                    PRINT31,ILLIAD                                      AVG3112
 6400  CONTINUE                                                         AVG3113
C-----THESE ARE S-WAVE PARAMETERS FOR A NON-FISSILE NUCLEUS.            AVG3114
C-----THESE ARE THE SAME AS THOSE READ IN AFTER READ CARDS 5 AND 6      AVG3115
      IF(NR-2)2085,95,88                                                AVG3116
   95 IF(NFLAG1)646,646,647                                             AVG3117
C-----8888888888888888888888888888888588888888888888888888888888888888AVG3118
  647           READ2,AWRI,BLA(5),LB,BLA(6),NJS,JB                    AVG3119
      PRINT35                                                           AVG3120
      PRINT25                                                           AVG3121
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      PRINT35                                                                AVG3122
                PRINT34,AWRI,LB,NJS                                          AVG3123
      JB=NJS                                                                 AVG3124
C-----999999999999999999999999999999999999999999999999999999999999999999AVG3125
      DO 648 I=1,JB                                                          AVG3126
                    READ2,BLA(7),BLA(8),LB,MUFB(I),BLA(9),BLA(10)            AVG3127
                    READ3,DAB(I),XJB(I),XXJB(I),GNOB(I),GGB(I),DRAT          AVG3128
      PRINT35                                                                AVG3129
                    PRINT30,DAB(I),XJB(I),GNOB(I),GGB(I)                     AVG3130
                    ILLIAD=INT(XXJB(I))                                      AVG3131
                    PRINT31,ILLIAD                                           AVG3132
                    PRINT32,MUFB(I)                                          AVG3133
                    READ3,(GFEB(II,I),II=1,NE)                               AVG3134
                    PRINT33                                                  AVG3135
                   PRINT3,(GFEB(II,I),II=1,NE)                               AVG3136
  648 CONTINUE                                                               AVG3137
C----=THESE ARE P-WAVE PARAMETERS FOR A FISSILE NUCLEUS.                     AVG3138
C-----LB=ANGULAR MOMENTUM,NJS=NUMBER OF SPIN STATES,JB=NJS FOR A NON-FISAVG3139
C-----SILE NUCLEUS,DAB(I)=MEAN LEVEL SPACING FOR THE I-TH SPIN STATE,    AVG3140
C----=XJB(I)=FLOATING PT. VALUE OF J FOR THE I-TH SPIN STATE,XXJB(I)=    AVG3141
C----=NUMBER OF DEGREES OF FREEDOM FOR NEUTRON WIDTH DISTRIBUTION FOR    AVG3142
C----=THE I=TH STATE,MUFB(I)=SAME FOR FISSION WIDTH DISTRIBUTION,        AVG3143
C----=GNOB(I)=REDUCED NEUTRON WIDTH  I-TH SPIN STATE=NEUTRON WIDTH(EV)/ AVG3144
C----=(XXJB(I)*SQRT(E)*PENETRATION FACTOR), IN CALCULATING THE PENETRATNAVG3145
C----=FACTOR ,THE NUCLEAR RADIUS USED IS GIVEN BY =(1.23*AWRI**(1/3)+0.8AVG3146
C-----)*0.1    WHERE AWRI=AWRI*1.008665,      GGB(I)=AVERAGE GAMMA WDTH AVG3147
C----=WIDTH,GFEB(II,I)=AVERAGE FISSION WIDTH FOR I-TH SPIN STATE AND     AVG3148
C----=II-TH ENERGY VALUE WHERE II VARIES FROM 1 TO NE.                   AVG3149
      GO TO 2085                                                         AVG3150
C----=AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAVG3151
  646           READ2,AWRI,BLA(9),LB,BLA(10),BLA(11),JB                    AVG3152
      PRINT25                                                              AVG3153
                PRINT34,AWRI,LB,JB                                         AVG3154
      DO 6460 I=1,JB                                                       AVG3155
                     READ3,DAB(I),XJB(I),XXJB(I),GNOB(I),GGB(I),DRAT      AVG3156
                    PRINT30,DAB(I),XJB(I),GNOB(I),GGB(I)                  AVG3157
                    ILLIAD=INT(XXJB(I))                                    AVG3158
                    PRINT31,ILLIAD                                         AVG3159
 6460 CONTINUE                                                             AVG3160
C----=THESE ARE P-WAVE PARAMETRS FOR A NON-FISSILE NUCLEUS, SOME OF      AVG3161
C----=THEM ARE THE SAME AS THE PARAMETRS DEFINED FOR A FISSILE NUCLEUS   AVG3162
C----=ABOVE AFTER READ CARD 9                                            AVG3163
 2085 T=2.196771E-03*(AWRI/(AWRI+1.0))                                     AVG3164
      CONST=19.7392088/(T*T)                                             AVG31641
      PHIFOR= 12.566371                                                  AVG3165
      ASS=AWRI*1.008665                                                  AVG3166
      CRT=ASS**(1.0/3.0)                                                 AVG3167
      APEN=(0.123*CRT+0.08)                                              AVG3168
      PRINT38,APEN                                                       AVG3169
      C=2.196771E-03*(AWRI/(AWRI+1.0))*A                                 AVG3170
      CPEN=2.196771E-03*(AWRI/(AWRI+1.0))*APEN                           AVG3171
      IF(NFLAG1)200,200,300                                              AVG3172
C     THIS TAKES CARE OF THE NONFISSILE NUCLEI                           AVG3173
  200 E=EO                                                               AVG3174
      I=1                                                                AVG3175
  204 GIG=0.0                                                            AVG3176
      GIS=0.0                                                            AVG3177
      ES(I)=E                                                            AVG3178
      E2=SQRT(E)                                                         AVG3179
      RHO=C*E2                                                           AVG3180
      RHOPEN=CPEN*E2                                                     AVG3181
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      RHO2=RHO**2                                                       AVG3182
      RHOPN2=RHOPEN**2                                                  AVG3183
      WAVE=2.196771E-03*E2*(AWRI/(AWRI+1.0))                            AVG3184
      PSS=RHO                                                           AVG3185
      PSP=RHO-ATAN (RHO)                                                AVG3186
      SIGPTS= (SIN (PSS)/WAVE)**2                                       AVG3187
      SIGPTS=SIGPTS*PHIFOR                                              AVG3188
      SIGPTP=(SIN(PSP)/WAVE)**2                                         AVG3189
      SIGPTP=SIGPTP*PHIFOR                                              AVG3190
      SIGPTP=3.0*SIGPTP                                                 AVG3191
      DO 201 J=1,JA                                                     AVG3192
      GJ=(2.0*XJA(J)+1.0)/(2.0*SPIN+1.0)                                AVG3193
      GJ=GJ/2.0                                                         AVG3194
      XXJAJ=XXJA(J)                                                     AVG3195
      GN=GNO(J)*E2*XXJAJ                                                AVG3196
      MU=INT (XXJAJ)                                                    AVG3197
      GAMMA=GG(J)                                                       AVG3198
      GALPHA=GN                                                         AVG3199
      GBETA=0.0                                                         AVG3200
      GF=0.0                                                            AVG3201
      TERM=(CONST*GJ*GN*GG(J))/(E*DA(J))                                AVG3202
      TERS=(CONST*GJ*GN*GN)/(E*DA(J))                                   AVG3203
      CALL GCAP(GALPHA,GBETA,GAMMA,GF,MU,GC)                            AVG3204
      CALL GSCAT(GALPHA,GBETA,GAMMA,GF,MU,GS)                           AVG3205
      GC=GC*TERM                                                        AVG3206
      GS=GS*TERS                                                        AVG3207
      CORR=(CONST*GJ*2.0*GN*SIN(PSS)*SIN(PSS))/(E*DA(J))                AVG32071
      GS=GS-CORR                                                        AVG32072
      GIG=GIG*GC                                                        AVG3208
      GIS=GIS*GS                                                        AVG3209
  201 CONTINUE                                                          AVG3210
      GIGGS(I)=GIG                                                      AVG3211
      GISS(I)=GIS*SIGPTS                                                AVG3212
      IF(NR-2)205,206,88                                                AVG3213
  206 GIG=0.0                                                           AVG3214
      GIS=0.0                                                           AVG3215
      DO 207 J=1,JB                                                     AVG3216
      GJ=(2.0*XJB(J)+1.0)/(2.0*SPIN+1.0)                                AVG3217
      GJ=GJ/2.0                                                         AVG3218
      VL=RHOPN2/(RHOPN2+1.0)                                            AVG3219
      XXJBJ=XXJB(J)                                                     AVG3220
      MU=INT (XXJBJ)                                                    AVG3221
      GN=GNOB(J)*E2*VL*XXJBJ                                            AVG3222
      GAMMA=GGB(J)                                                      AVG3223
      GF=0.0                                                            AVG3224
      GALPHA=GN                                                         AVG3225
      GBETA=0.0                                                         AVG3226
      TERM=(CONST*GJ*GN*GGB(J))/(E*DAB(J))                              AVG3227
      TERS=(CONST*GJ*GN*GN)/(E*DAB(J))                                  AVG3228
      CALL GCAP(GALPHA,GBETA,GAMMA,GF,MU,GC)                            AVG3229
      CALL GSCAT(GALPHA,GBETA,GAMMA,GF,MU,GS)                           AVG3230
      GC=GC*TERM                                                        AVG3231
      GS=GS*TERS                                                        AVG3232
      CORR=(CONST*GJ*2.0*GN*SIN(PSP)*SIN(PSP))/(E*DAB(J))               AVG32321
      GS=GS-CORR                                                        AVG32322
      GIG=GIG*GC                                                        AVG3233
      GIS=GIS*GS                                                        AVG3234
  207 CONTINUE                                                          AVG3235
      GIGGP(I)=GIG                                                      AVG3236
      GISP(I)=GIS*SIGPTP                                                AVG3237
  205 E=E*ESTEP                                                         AVG3238
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      IF(E.GT.EN)GO TO 202                                              AVG3239
      GO TO 203                                                         AVG32391
  203 I=I+1                                                             AVG3240
      GO TO 204                                                         AVG3241
  202 NC=I                                                              AVG3242
      GO TO 400                                                         AVG3243
  300 DO 210 I=1,NE                                                     AVG3244
      E=ES(I)                                                           AVG3245
      E2=SQRT(E)                                                        AVG3246
      RHO=C*E2                                                          AVG3247
      RHOPEN=CPEN*E2                                                    AVG3248
      WAVE=2.196771E-03*E2*(AWRI/(AWRI+1.0))                            AVG3249
      PSS=RHO                                                           AVG3250
      PSP=RHO*ATAN (RHO)                                                AVG3251
      SIGPTS=(SIN(PSS)/WAVE)**2                                         AVG3252
      SIGPTS=SIGPTS*PHIFOR                                              AVG3253
      SIGPTP=(SIN(PSP)/WAVE)**2                                         AVG3254
      SIGPTP=SIGPTP*PHIFOR                                              AVG3255
      SIGPTP=3.0*SIGPTP                                                 AVG3256
      RHO2=RHO**2                                                       AVG3257
      RHOPN2=RHOPEN**2                                                  AVG3258
      VL=RHOPN2/(RHOPN2+1.0)                                            AVG3259
      GIG=0.0                                                           AVG3260
      GIF=0.0                                                           AVG3261
      GIS=0.0                                                           AVG3262
      DO 211J=1,JA                                                      AVG3263
      GJ=(2.0*XJA(J)+1.0)/(2.0*SPIN+1.0)                                AVG3264
      GJ=GJ/2.0                                                         AVG3265
      XXJAJ=XXJA(J)                                                     AVG3266
      MU=INT (XXJAJ)                                                    AVG3267
      NU=MUFA(J)                                                        AVG3268
      GN=GNO(J)*E2*XXJAJ                                                AVG3269
      GAMMA=GG(J)                                                       AVG3270
      GALPHA=GN                                                         AVG3271
      GBETA=GFE(I,J)                                                    AVG3272
      TERM=(CONST*GJ*GN*GFE(I,J))/(E*DA(J))                             AVG3273
      TERG=(CONST*GJ*GG(J)*GN)/(E*DA(J))                                AVG3274
      TERS=(CONST*GJ*GN*GN)/(E*DA(J))                                   AVG3275
      CALL GFIS(GALPHA,GBETA,GAMMA,MU,NU,GS)                            AVG3276
      CALL GSPE(GALPHA,GBETA,GAMMA,MU,NU,GC)                            AVG3277
      CALL SCAF(GALPHA,GBETA,GAMMA,MU,NU,SF)                            AVG3278
      GS=GS*TERM                                                        AVG3279
      GC=GC*TERG                                                        AVG3280
      SF=SF*TERS                                                        AVG3281
      CORR=(CONST*GJ*2.0*GN*SIN(PSS)*SIN(PSS))/(E*DA(J))                AVG32811
      SF=SF-CORR                                                        AVG32812
      GIG=GIG+GC                                                        AVG3282
      GIF=GIF+GS                                                        AVG3283
      GIS=GIS+SF                                                        AVG3284
  211 CONTINUE                                                          AVG3285
      GIGGS(I)=GIG                                                      AVG3286
      GIGFS(I)=GIF                                                      AVG3287
      GISS(I)=GIS+SIGPTS                                                AVG3288
      IF(NR-2)210,212,88                                                AVG3289
  212 GIG=0.0                                                           AVG3290
      GIF=0.0                                                           AVG3291
      GIS=0.0                                                           AVG3292
      DO 213 J=1,JB                                                     AVG3293
      GJ=(2.0*XJB(J)+1.0)/(2.0*SPIN+1.0)                                AVG3294
      GJ=GJ/2.0                                                         AVG3295
      XXJBJ=XXJB(J)                                                     AVG3296
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      MU=INT (XXJBJ)                                                    AVG3297
      NU=MUFB(J)                                                        AVG3298
      GN=GNOB(J)*E2*XXJBJ*VL                                            AVG3299
      GAMMA=GGB(J)                                                      AVG3300
      GALPHA=GN                                                         AVG3301
      GBETA=GFEB(I,J)                                                   AVG3302
      TERM=(CONST*GJ*GFEB(I,J)*GN)/(E*DAB(J))                           AVG3303
      TERG=(CONST*GJ*GN*GGB(J))/(E*DAB(J))                              AVG3304
      TERS=(CONST*GJ*GN*GN)/(E*DAB(J))                                  AVG3305
      CALL GFIS(GALPHA,GBETA,GAMMA,MU,NU,GS)                            AVG3306
      CALL GSPE(GALPHA,GBETA,GAMMA,MU,NU,GC)                            AVG3307
      CALL SCAF(GALPHA,GBETA,GAMMA,MU,NU,SF)                            AVG3308
      GS=GS*TERM                                                        AVG3309
      GC=GC*TERG                                                        AVG3310
      SF=SF*TERS                                                        AVG3311
      CORR=(CONST*GJ*2.0*GN*SIN(PSP)*SIN(PSP))/(E*DAB(J))               AVG33111
      SF=SF+CORR                                                        AVG33112
      GIG=GIG*GC                                                        AVG3312
      GIF=GIF*GS                                                        AVG3313
      GIS=GIS*SF                                                        AVG3314
  213 CONTINUE                                                          AVG3315
      GIGGP(I)=GIG                                                      AVG3316
      GIGFP(I)=GIF                                                      AVG3317
      GISP(I)=GIS*SIGPTP                                                AVG3318
  210 CONTINUE                                                          AVG3319
      GO TO 410                                                         AVG3320
  400 PRINT10                                                           AVG3321
   10 FORMAT(72H AVERAGE SCATTERING AND CAPTURE CROSS-SECTIONS FOR A NONAVG3322
     1-FISSILE NUCLEUS)                                                 AVG3323
      PRINT11,(RUN(J),J=1,7)                                            AVG3324
   11 FORMAT(9H TITLE   7A4)                                            AVG3325
      PRINT12,E0,EN                                                     AVG3326
   12 FORMAT(24H ENERGY LIMITS    LOWER E10.4,10H    UPPER E10.4)        AVG3327
      GO TO (401,402),NR                                                AVG3328
  401 PRINT21                                                           AVG3329
      PRINT36                                                           AVG3330
      PRINT14,(ES(I),GISS(I),I=1,NC)                                    AVG3331
      PRINT35                                                           AVG3332
      PRINT13                                                           AVG3333
   13 FORMAT(53H  NEUTRON ENERGY(EV)      S-WAVE CAPTURE  ROSS-SECTION) AVG3334
   36 FORMAT(53H  NEUTRON ENERGY(EV)      S-WAVE SCATRNG CROSS-SECTION) AVG3335
   14 FORMAT(2E20.6)                                                    AVG3336
      PRINT14,(ES(I),GIGGS(I),I=1,NC)                                   AVG3337
      GO TO 880                                                         AVG3338
  402 PRINT21                                                           AVG3339
      PRINT37                                                           AVG3340
      DO 7001 I=1,NC                                                    AVG3341
      TOTAL=GISS(I)+GISP(I)                                             AVG3342
      PRINT16,ES(I),GISS(I),GISP(I),TOTAL                               AVG3343
 7001 CONTINUE                                                          AVG3344
      PRINT35                                                           AVG3345
      PRINT15                                                           AVG3346
   15 FORMAT(110H NEUTRON ENERGY(EV)      S-WAVE CAPTURE CROSS-SECTION  AVG3347
     1    P-WAVE CAPTURE CROSS-SECTION                    TOTAL)        AVG3348
   37 FORMAT(110H NEUTRON ENERGY(EV)      S-WAVE SCATRNG CROSS-SECTION  AVG3349
     1    P-WAVE SCATRNG CROSS-SECTION                    TOTAL)        AVG3350
   16 FORMAT(4X,E13.4,17X,E13.6,21X,E13.6,21X,E13.6)                    AVG3351
      DO 7000 I=1,NC                                                    AVG3352
      TOTAL=GIGGS(I)+GIGGP(I)                                           AVG3353
      PRINT16,ES(I),GIGGS(I),GIGGP(I),TOTAL                             AVG3354
 7000 CONTINUE                                                          AVG3355
```

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      GO TO 880                                                          AVG3356
  410 PRINT17                                                            AVG3357
   17 FORMAT(76H AVERAGE SCATTERING CAPTURE AND FISSION CROSS-SECTIONS FAVG3358
     1OR A FISSILE NUCLEUS)                                              AVG3359
      PRINT11,(RUN(J),J=1,7)                                             AVG3360
      GO TO (411,412),NR                                                 AVG3361
  411 PRINT21                                                            AVG3362
      PRINT36                                                            AVG3363
      PRINT14,(ES(I),GISS(I),I=1,NE)                                     AVG3364
      PRINT35                                                            AVG3365
      PRINT13                                                            AVG3366
      PRINT14,(ES(I),GIGGS(I),I=1,NE)                                    AVG3367
      PRINT18                                                            AVG3368
   18 FORMAT(53H  NEUTRON ENERGY(EV)     S-WAVE FISSION CROSS-SECTION)   AVG3369
      PRINT14,(ES(I),GIGFS(I),I=1,NE)                                    AVG3370
      GO TO 880                                                          AVG3371
  412 PRINT21                                                            AVG3372
      PRINT37                                                            AVG3373
      DO 7002 I=1,NE                                                     AVG3374
      TOTAL=GISS(I)+GISP(I)                                              AVG3375
      PRINT16,ES(I),GISS(I),GISP(I),TOTAL                                AVG3376
 7002 CONTINUE                                                           AVG3377
      PRINT35                                                            AVG3378
      PRINT15                                                            AVG3379
      DO 7003 I=1,NE                                                     AVG3380
      TOTAL=GIGGS(I)+GIGGP(I)                                            AVG3381
      PRINT16,ES(I),GIGGS(I),GIGGP(I),TOTAL                              AVG3382
 7003 CONTINUE                                                           AVG3383
      PRINT19                                                            AVG3384
   19 FORMAT(110H NEUTRON ENERGY(EV)     S-WAVE FISSION CROSS-SECTION    AVG3385
     1      P-WAVE NEUTRON CROSS-SECTION                 TOTAL)          AVG3386
      DO 7004 I=1,NE                                                     AVG3387
      TOTAL=GIGFS(I)+GIGFP(I)                                            AVG3388
      PRINT16,ES(I),GIGFS(I),GIGFP(I),TOTAL                              AVG3389
 7004 CONTINUE                                                           AVG3390
      GO TO 880                                                          AVG3391
   88 PRINT20                                                            AVG3392
   20 FORMAT(47H INPUT ERROR NUMBER OF L VALUES LARGER THAN TWO)         AVG3393
   21 FORMAT(62H AVERAGE CROSS-SECTIONS CALCULTED USING GREEBLER APPROXIAVG3394
     1MATION)                                                            AVG3395
   22 FORMAT(31H DATA FOR A NON-FISSILE NUCLEUS)                         AVG3396
   23 FORMAT(27H DATA FOR A FISSILE NUCLEUS)                             AVG3397
   24 FORMAT(12H S-WAVE DATA)                                            AVG3398
C     CONTINUE                                                          AVG3399
   25 FORMAT(12H P-WAVE DATA)                                            AVG3400
   26 FORMAT(20H ENERGY LIMITS LOWERE20.6,7H  UPPERE20.6,7H   LRU=I5,7H AVG3401
     1  LRF=I5,7H   LFI=I5)                                             AVG3402
   27 FORMAT(7H RUN NOI5,9H  TITLE  7A4,4H  EOE13.6,4H  ENE13.6,7H  ESTEAVG3403
     1PE13.6)                                                          AVG34031
   28 FORMAT(12H TARGET SPINE11.4,18H SCATTERING LENGTHE11.4,54H NO OF EAVG3404
     1NERGY VALUES AT WHICH FISSION WIDTHS ARE GIVENI5)                 AVG3405
   29 FORMAT(51H FISSION WIDTHS ARE GIVEN AT THE FOLLOWING ENERGIES)     AVG3406
   30 FORMAT(19H MEAN LEVEL SPACINGE11.4,11H LEVEL SPINE11.4,22H REDUCEDAVG3407
     1 NEUTRON WIDTHE11.4,12H GAMMA GAMMAE11.4)                         AVG3408
   31 FORMAT(56H NO OF DEGREES OF FREEDOM FOR NEUTRON WIDTH DISTRIBUTIONAVG3409
     1I7)                                                               AVG3410
   32 FORMAT(56H NO OF DEGREES OF FREEDOM FOR FISSION WIDTH DISTRIBUTIONAVG3411
     1I7)                                                               AVG3412
   33 FORMAT(23H THE FISSION WIDTHS ARE)                                AVG3413
   34 FORMAT(14H ISOTOPIC MASSE11.4,17H ANGULAR MOMENTUMI5,18H NO OF SPIAVG3414
     1N STATESI5)                                                       AVG3415
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 35 FORMAT(//)                                                          AVG3416
 38 FORMAT(46H NUCLEAR RADIUS A=(1.23*MASS**1/3+0.8)*0.1   =E11.4)      AVG3417
 39 FORMAT(80H1 PROGRAM AVRAGE3, CALCULATES CROSS-SECTIONS IN THE UNREAVG3418
   1SOLVED RESONANCE REGION.)                                           AVG3419
 40 FORMAT(59H ENDF/B VERSION II DATA WITH ENERGY INDEPENDENT PARAMETEAVG3420
   1RS.)                                                                AVG3421
880 GO TO 881                                                           AVG3422
8800 RETURN                                                             AVG3423
     END                                                                AVG3424
     SUBROUTINE GCAP(GALPHA,GBETA,GAMMA,GGF,MU,SC)                      GCAP001
     COMMON/XBAR/XX(4,10)                                               GCAP002
     SC=0.0                                                             GCAP003
     DO 100 J=1,10                                                      GCAP004
     XJ=XX(MU,J)                                                        GCAP005
     VALUE=XJ/(GALPHA*XJ+GBETA*GGF+GAMMA)                               GCAP006
     SC=SC+VALUE                                                        GCAP007
100 CONTINUE                                                            GCAP008
     SC=SC/10.0                                                         GCAP009
     RETURN                                                             GCAP010
     END                                                                GCAP011
     SUBROUTINE GFIS(GALPHA,GBETA,GAMMA,MU,NU,S)                        GFIS001
     COMMON/XBAR/XX(4,10)                                               GFIS002
     S=0.0                                                              GFIS003
     DO 100 J=1,10                                                      GFIS004
     YJ=XX(NU,J)                                                        GFIS005
     CALL GCAP(GALPHA,GBETA,GAMMA,YJ,MU,SC)                             GFIS006
     S=S+YJ*SC                                                          GFIS007
100 CONTINUE                                                            GFIS008
     S=S/10.0                                                           GFIS009
     RETURN                                                             GFIS010
     END                                                                GFIS011
     SUBROUTINE GSPE(GALPHA,GBETA,GAMMA,MU,NU,S)                        GSPE001
     COMMON/XBAR/XX(4,10)                                               GSPE002
     S=0.0                                                              GSPE003
     DO 100 J=1,10                                                      GSPE004
     YJ=XX(NU,J)                                                        GSPE005
     CALL GCAP(GALPHA,GBETA,GAMMA,YJ,MU,SC)                             GSPE006
     S=S+SC                                                             GSPE007
100 CONTINUE                                                            GSPE008
     S=S/10.0                                                           GSPE009
     RETURN                                                             GSPE010
     END                                                                GSPE011
     SUBROUTINE GSCAT(GALPHA,GBETA,GAMMA,GGF,MU,SC)                     GSCT001
     COMMON/XBAR/XX(4,10)                                               GSCT002
     SC=0.0                                                             GSCT003
     DO 100 J=1,10                                                      GSCT004
     XJ=XX(MU,J)                                                        GSCT005
     VALUE=(XJ*XJ)/(GALPHA*XJ+GBETA*GGF+GAMMA)                          GSCT006
     SC=SC+VALUE                                                        GSCT007
100 CONTINUE                                                            GSCT008
     SC=SC/10.0                                                         GSCT009
     RETURN                                                             GSCT010
     END                                                                GSCT011
     SUBROUTINE SCAF(GALPHA,GBETA,GAMMA,MU,NU,S)                        SCAF001
     COMMON/XBAR/XX(4,10)                                               SCAF002
     S=0.0                                                              SCAF003
     DO 100 J=1,10                                                      SCAF004
     YJ=XX(NU,J)                                                        SCAF005
     CALL GSCAT(GALPHA,GBETA,GAMMA,YJ,MU,SC)                            SCAF006
     S=S+SC                                                             SCAF007
100 CONTINUE                                                            SCAF008
```

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S=S/10.0                                                    SCAF009
RETURN                                                      SCAF010
END                                                         SCAF011
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       1 AVERAGE3 TEST,PU=239 DATA
3.00000+ 2 1.00000+ 5           2           1           0           01051 2151  203
5.00000- 1 9.05000- 1           0           0          16           21051 2151  204
3.00000+ 2 6.00000+ 2 1.00000+ 3 1.50000+ 3 2.50000+ 3 3.50000+ 3 31051 2151  205
5.00000+ 3 8.00000+ 3 1.30000+ 4 2.00000+ 4 3.00000+ 4 4.00000+ 4 41051 2151  206
5.00000+ 4 6.00000+ 4 8.00000+ 4 1.00000+ 5                        1051 2151  207
236,9985   0.      + 0           0           0           2           01051 2151  208
0.      + 0 0.      + 0           0           2          22           01051 2151  209
8.78000+ 0 0.      + 0 1.00000+ 0 9.40000- 4 3.87000- 2 0.      + 01051 2151  210
2.80000+ 0 2.80000+ 0 2.80000+ 0 2.80000+ 0 2.80000+ 0 2.80000+ 0 01051 2151  211
2.80000+ 0 2.80000+ 0 2.80000+ 0 2.80000+ 0 2.80000+ 0 2.80000+ 0 01051 2151  212
2.80000+ 0 2.80000+ 0 2.80000+ 0 2.80000+ 0
0.      + 0 0.      + 0           0           1          22           01051 2151  214
3.12000+ 0 1.00000+ 0 1.00000+ 0 3.34000- 4 3.87000- 2 0.      + 01051 2151  215
5.52000- 2 5.59000- 2 5.68000- 2 5.78000- 2 5.93200- 2 6.23000- 21051 2151  216
6.57000- 2 7.33000- 2 8.72000- 2 1.10200- 1 1.50200- 1 1.97500- 11051 2151  217
2.48000- 1 3.00000- 1 3.86000- 1 4.85000- 1                        1051 2151  218
236,9985   0.00000+00           1           0           3           01051 2151  219
0.      + 0 0.      + 0           1           2          22           01051 2151  220
8.78000+00 0.      + 0 1.00000+00 2.19500-03 3.87000-02 0.      + 01051 2151
 .04000      .04000      .04000      .04000      .04000      .04000
 .04000      .04000      .04000      .04000      .04000      .04000
 .04000      .04000      .04000      .04000      .04000      .04000
0.00000+00 0.00000+00           1           2          22           0
3.12000+00 1.00000+00 2.00000+00 7.80000-04 3.87000-02 0.00000+00
 .04000      .04000      .04000      .04000      .04000      .04000
 .04000      .04000      .04000      .04000      .04000      .04000
 .04000      .04000      .04000      .04000      .04000      .04000
0.00000+00 0.00000+00           1           2          22           0
2.12000+00 2.00000+00 1.00000+00 5.30000-04 3.87000-02 0.00000+00
 .04000      .04000      .04000      .04000      .04000      .04000
 .04000      .04000      .04000      .04000      .04000      .04000
 .04000      .04000      .04000      .04000      .04000      .04000
       2AVERAGE3 TEST,U-238DATA        0.1000E+040.1000E+060.1000E+04
3.9200E+03 5.0000E+04           2           1           0
      0.0      0.9184           1           0           2           01047 2151  226
236,0058           0.0           0           0           6           11047 2151  227
      18.5         0.5         1.0     1.739-3      24.6-3         0.01047 2151  228
236,0058           0.0           1           0          12           21047 2151  229
      18.5         0.5         1.0     2.923-3      24.6-3         0.01047 2151  230
      9.25         1.5         1.0    1.4615-3      24.6-3         0.01047 2151  23
       3 AVERAGE3 TEST, U-235 DATA
6.4504E+01    5.0E+04           2           1           0           01044 2151  186
       3.5 8.3668E-01           0           0          25           21044 2151  187
6.4504E+01    8.2E+01   1.25E+02    1.75E+02    2.25E+02    2.75E+021044 2151  188
  3.50E+02    4.50E+02    6.00E+02    8.50E+02    1.25E+03    1.75E+031044 2151  189
  2.50E+03    3.50E+03    4.50E+03    5.50E+03    7.00E+03    9.00E+031044 2151  190
  1.25E+04    1.75E+04    2.25E+04    2.75E+04    3.50E+04    4.50E+041044 2151  191
  5.00E+04                                                        1044 2151  192
233,0247           0.0           0           0           2           01044 2151  193
       0.0         0.0           0           2          31           01044 2151  194
      1.00         3.0         1.0     1.0E-04       0.035         0.01044 2151  195
2.9474E-01 2.9264E-01 2.4623E-01 2.4258E-01 2.6413E-01 4.9705E-011044 2151  196
2.7310E-01 4.5109E-01 4.4004E-01 2.3327E-01 3.0220E-01 3.5300E-011044 2151  197
4.2449E-01 3.2358E-01 3.2196E-01 3.2284E-01 3.3009E-01 3.3291E-011044 2151  198
4.3837E-01 4.3870E-01 4.5035E-01 4.7280E-01 5.2078E-01 5.9992E-011044 2151  199
5.7033E-01                                                      1044 2151  200
       0.0         0.0           0           1          31           01044 2151  201
      1.00         4.0         1.0     1.0E-04       0.035         0.01044 2151  202
1.4737E-01 1.4632E-01 1.2311E-01 1.2129E-01 1.3207E-01 2.4852E-011044 2151  203
1.3655E-01 2.2554E-01 2.2002E-01 1.1663E-01 1.5110E-01 1.7650E-011044 2151  204
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2.1225E-01 1.6179E-01 1.6098E-01 1.6142E-01 1.6505E-01 1.6646E-011044 2151  205
2.1918E-01 2.1935E-01 2.2517E-01 2.3640E-01 2.6039E-01 2.9996E-011044 2151  206
2.8517E-01                                                        1044 2151  207
233,0247          0,0          1            0           4          01044 2151  208
       2,0        0,0          1            2          31          01044 2151  209
      1,16        2,0        1,0     2,32E-04       0,035        0,01044 2151  210
  3,32E-01    3,32E-01    3,32E-01    3,32E-01    3,32E-01    3,32E-011044 2151  211
  3,32E-01    3,32E-01    3,32E-01    3,32E-01    3,32E-01    3,32E-011044 2151  212
  3,32E-01    3,32E-01    3,32E-01    3,32E-01    3,32E-01    3,32E-011044 2151  213
  3,32E-01    3,32E-01    3,32E-01    3,32E-01    3,32E-01    3,32E-011044 2151  214
  3,32E-01                                                        1044 2151  215
       0,0        0,0          1            1          31          01044 2151  216
      1,00        3,0        2,0     2,00E-04       0,035        0,01044 2151  217
  1,27E-01    1,27E-01    1,27E-01    1,27E-01    1,27E-01    1,27E-011044 2151  218
  1,27E-01    1,27E-01    1,27E-01    1,27E-01    1,27E-01    1,27E-011044 2151  219
  1,27E-01    1,27E-01    1,27E-01    1,27E-01    1,27E-01    1,27E-011044 2151  220
  1,27E-01    1,27E-01    1,27E-01    1,27E-01    1,27E-01    1,27E-011044 2151  221
  1,27E-01                                                        1044 2151  222
       0,0        0,0          1            2          31          01044 2151  223
      1,00        4,0        2,0     2,00E-04       0,035        0,01044 2151  224
  2,86E-01    2,86E-01    2,86E-01    2,86E-01    2,86E-01    2,86E-011044 2151  225
  2,86E-01    2,86E-01    2,86E-01    2,86E-01    2,86E-01    2,86E-011044 2151  226
  2,86E-01    2,86E-01    2,86E-01    2,86E-01    2,86E-01    2,86E-011044 2151  227
  2,86E-01    2,86E-01    2,86E-01    2,86E-01    2,86E-01    2,86E-011044 2151  228
  2,86E-01                                                        1044 2151  229
       0,0        0,0          1            1          31          01044 2151  230
      1,12        5,0        1,0     2,24E-04       0,035        0,01044 2151  231
  1,43E-01    1,43E-01    1,43E-01    1,43E-01    1,43E-01    1,43E-011044 2151  232
  1,43E-01    1,43E-01    1,43E-01    1,43E-01    1,43E-01    1,43E-011044 2151  233
  1,43E-01    1,43E-01    1,43E-01    1,43E-01    1,43E-01    1,43E-011044 2151  234
  1,43E-01    1,43E-01    1,43E-01    1,43E-01    1,43E-01    1,43E-011044 2151  235
  1,43E-01                                                        1044 2151  236
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PROGRAM AVRAGE3, CALCULATES CROSS-SECTIONS IN THE UNRESOLVED RESONANCE REGION.

ENDF/B VERSION II DATA WITH ENERGY INDEPENDENT PARAMETERS.

RUN NO 1 TITLE AVERAGE3 TEST,PU-239 DATA EO 0.000000E+00 EN 0.000000E+00 ESTEP 0.000000E+00
ENERGY LIMITS LOWER 3.000000E+02 UPPER 1.000000E+05 LRU= 2 LRF= 1 LFI= 0
TARGET SPIN 5.0000E-01 SCATTERING LENGTH 9.0500E-01 NO OF ENERGY VALUES AT WHICH FISSION WIDTHS ARE GIVEN
DATA FOR A FISSILE NUCLEUS

S-WAVE DATA

FISSION WIDTHS ARE GIVEN AT THE FOLLOWING ENERGIES
3.0000E+02 6.0000E+02 1.0000E+03 1.5000E+03 2.5000E+03 3.5000E+03
5.0000E+03 8.0000E+03 1.3000E+04 2.0000E+04 3.0000E+04 4.0000E+04
5.0000E+04 6.0000E+04 8.0000E+04 1.0000E+05
ISOTOPIC MASS 2.3700E+02 ANGULAR MOMENTUM 0 NO OF SPIN STATES 2

MEAN LEVEL SPACING 8.7800E+00 LEVEL SPIN 0.0000E+00 REDUCED NEUTRON WIDTH 9.4000E-04 GAMMA GAMMA 3.8700E-0
NO OF DEGREES OF FREEDOM FOR NEUTRON WIDTH DISTRIBUTION 1
NO OF DEGREES OF FREEDOM FOR FISSION WIDTH DISTRIBUTION 2
THE FISSION WIDTHS ARE
2.8000E+00 2.8000E+00 2.8000E+00 2.8000E+00 2.8000E+00 2.8000E+00
2.8000E+00 2.8000E+00 2.8000E+00 2.8000E+00 2.8000E+00 2.8000E+00
2.8000E+00 2.8000E+00 2.8000E+00 2.8000E+00

MEAN LEVEL SPACING 3.1200E+00 LEVEL SPIN 1.0000E+00 REDUCED NEUTRON WIDTH 3.3400E-04 GAMMA GAMMA 3.8700E-0
NO OF DEGREES OF FREEDOM FOR NEUTRON WIDTH DISTRIBUTION 1
NO OF DEGREES OF FREEDOM FOR FISSION WIDTH DISTRIBUTION 1
THE FISSION WIDTHS ARE
5.5200E-02 5.5900E-02 5.6800E-02 5.7800E-02 5.9320E-02 6.2300E-02
6.5700E-02 7.3300E-02 8.7200E-02 1.1020E-01 1.5020E-01 1.9750E-01
2.4800E-01 3.0000E-01 3.8600E-01 4.8500E-01

P-WAVE DATA

ISOTOPIC MASS 2.3700E+02 ANGULAR MOMENTUM 1 NO OF SPIN STATES 3

MEAN LEVEL SPACING 8.7800E+00 LEVEL SPIN 0.0000E+00 REDUCED NEUTRON WIDTH 2.1950E-03 GAMMA GAMMA 3.8700E-0
NO OF DEGREES OF FREEDOM FOR NEUTRON WIDTH DISTRIBUTION 1
NO OF DEGREES OF FREEDOM FOR FISSION WIDTH DISTRIBUTION 2
THE FISSION WIDTHS ARE
4.0000E-02 4.0000E-02 4.0000E-02 4.0000E-02 4.0000E-02 4.0000E-02
4.0000E-02 4.0000E-02 4.0000E-02 4.0000E-02 4.0000E-02 4.0000E-02

4.0000E-02 4.0000E-02 4.0000E-02 4.0000E-02

MEAN LEVEL SPACING 3.1200E+00 LEVEL SPIN 1.0000E+00 REDUCED NEUTRON WIDTH 7.8000E-04 GAMMA GAMMA 3.8700E-02
NO OF DEGREES OF FREEDOM FOR NEUTRON WIDTH DISTRIBUTION 2
NO OF DEGREES OF FREEDOM FOR FISSION WIDTH DISTRIBUTION 2
THE FISSION WIDTHS ARE
4.0000E-02 4.0000E-02 4.0000E-02 4.0000E-02 4.0000E-02 4.0000E-02
4.0000E-02 4.0000E-02 4.0000E-02 4.0000E-02 4.0000E-02 4.0000E-02
4.0000E-02 4.0000E-02 4.0000E-02 4.0000E-02

MEAN LEVEL SPACING 2.1200E+00 LEVEL SPIN 2.0000E+00 REDUCED NEUTRON WIDTH 5.3000E-04 GAMMA GAMMA 3.8700E-02
NO OF DEGREES OF FREEDOM FOR NEUTRON WIDTH DISTRIBUTION 1
NO OF DEGREES OF FREEDOM FOR FISSION WIDTH DISTRIBUTION 2
THE FISSION WIDTHS ARE
4.0000E-02 4.0000E-02 4.0000E-02 4.0000E-02 4.0000E-02 4.0000E-02
4.0000E-02 4.0000E-02 4.0000E-02 4.0000E-02 4.0000E-02 4.0000E-02
4.0000E-02 4.0000E-02 4.0000E-02 4.0000E-02
NUCLEAR RADIUS A=(1.23*MASS**1/3+0.8)*0.1 = 8.4337E-01
AVERAGE SCATTERING CAPTURE AND FISSION CROSS-SECTIONS FOR A FISSILE NUCLEUS
TITLE AVERAGE3 TEST,PU-239 DATA
AVERAGE CROSS-SECTIONS CALCULTED USING GREEBLER APPROXIMATION

NEUTRON ENERGY(EV)	S-WAVE SCATRNG CROSS-SECTION	P-WAVE SCATRNG CROSS-SECTION	TOTAL
3.000000E+02	1.383416E+01	1.296935E-04	1.383429E+01
6.000000E+02	1.347005E+01	5.165503E-04	1.347056E+01
1.000000E+03	1.316930E+01	1.425274E-03	1.317073E+01
1.500000E+03	1.291372E+01	3.176370E-03	1.291690E+01
2.500000E+03	1.257470E+01	8.631692E-03	1.258333E+01
3.500000E+03	1.232965E+01	1.650611E-02	1.234616E+01
5.000000E+03	1.206458E+01	3.235447E-02	1.209694E+01
8.000000E+03	1.169198E+01	7.591461E-02	1.176790E+01
1.300000E+04	1.127335E+01	1.724855E-01	1.144583E+01
2.000000E+04	1.085939E+01	3.332512E-01	1.119264E+01
3.000000E+04	1.041848E+01	5.767438E-01	1.099523E+01
4.000000E+04	1.006689E+01	8.139086E-01	1.088080E+01
5.000000E+04	9.769172E+00	1.036500E+00	1.080567E+01
6.000000E+04	9.506816E+00	1.242964E+00	1.074978E+01
8.000000E+04	9.057618E+00	1.611006E+00	1.066862E+01
1.000000E+05	8.660133E+00	1.928741E+00	1.058887E+01

NEUTRON ENERGY(EV)	S-WAVE CAPTURE CROSS-SECTION	P-WAVE CAPTURE CROSS-SECTION	TOTAL
3.000000E+02	9.295319E+00	1.070727E-01	9.402392E+00
6.000000E+02	6.096594E+00	1.510540E-01	6.247648E+00
1.000000E+03	4.415238E+00	1.942551E-01	4.609493E+00
1.500000E+03	3.391673E+00	2.365860E-01	3.628259E+00
2.500000E+03	2.410175E+00	3.014797E-01	2.711655E+00
3.500000E+03	1.901494E+00	3.514680E-01	2.252962E+00
5.000000E+03	1.472163E+00	4.098882E-01	1.882051E+00
8.000000E+03	1.035008E+00	4.911123E-01	1.526120E+00
1.300000E+04	7.044900E-01	5.685306E-01	1.273021E+00
2.000000E+04	4.887805E-01	6.162974E-01	1.105078E+00
3.000000E+04	3.372530E-01	6.302902E-01	9.675432E-01
4.000000E+04	2.546110E-01	6.181940E-01	8.728050E-01
5.000000E+04	2.032893E-01	5.963265E-01	7.996159E-01
6.000000E+04	1.685889E-01	5.712251E-01	7.398140E-01
8.000000E+04	1.267224E-01	5.210052E-01	6.477276E-01

NEUTRON ENERGY(EV)	S-WAVE FISSION CROSS-SECTION	P-WAVE NEUTRON CROSS-SECTION	TOTAL
1.000000E+05	1.003823E-01	4.757889E-01	5.761712E-01
3.000000E+02	1.258808E+01	7.497054E-02	1.266305E+01
6.000000E+02	8.656434E+00	1.058106E-01	8.762245E+00
1.000000E+03	6.545967E+00	1.361744E-01	6.682141E+00
1.500000E+03	5.232006E+00	1.660404E-01	5.398047E+00
2.500000E+03	3.930985E+00	2.121837E-01	4.143168E+00
3.500000E+03	3.272720E+00	2.481861E-01	3.520906E+00
5.000000E+03	2.688795E+00	2.910436E-01	2.979838E+00
8.000000E+03	2.087673E+00	3.529282E-01	2.440601E+00
1.300000E+04	1.624818E+00	4.168780E-01	2.041696E+00
2.000000E+04	1.322805E+00	4.635778E-01	1.786382E+00
3.000000E+04	1.111848E+00	4.884854E-01	1.600334E+00
4.000000E+04	9.945280E-01	4.905240E-01	1.485052E+00
5.000000E+04	9.143779E-01	4.821877E-01	1.396566E+00
6.000000E+04	8.537798E-01	4.690790E-01	1.322859E+00
8.000000E+04	7.561141E-01	4.381376E-01	1.194252E+00
1.000000E+05	6.926187E-01	4.071883E-01	1.099807E+00

PROGRAM AVRAGE3, CALCULATES CROSS-SECTIONS IN THE UNRESOLVED RESONANCE REGION.

ENDF/B VERSION II DATA WITH ENERGY INDEPENDENT PARAMETERS.

RUN NO 2 TITLE AVERAGE3 TEST,U-238DATA EO 1.000000E+03 EN 1.000000E+05 ESTEP 1.000000E+03
ENERGY LIMITS LOWER 3.920000E+03 UPPER 5.000000E+04 LRU= 2 LRF= 1 LFI= 0
TARGET SPIN 0.0000E+00 SCATTERING LENGTH 9.1840E-01 NO OF ENERGY VALUES AT WHICH FISSION WIDTHS ARE GIVEN 2
DATA FOR A NON-FISSILE NUCLEUS

S-WAVE DATA

ISOTOPIC MASS 2.3601E+02 ANGULAR MOMENTUM 0 NO OF SPIN STATES 1
MEAN LEVEL SPACING 1.8500E+01 LEVEL SPIN 5.0000E-01 REDUCED NEUTRON WIDTH 1.7390E-03 GAMMA GAMMA 2.4600E-02
NO OF DEGREES OF FREEDOM FOR NEUTRON WIDTH DISTRIBUTION 1
P-WAVE DATA
ISOTOPIC MASS 2.3601E+02 ANGULAR MOMENTUM 1 NO OF SPIN STATES 2
MEAN LEVEL SPACING 1.8500E+01 LEVEL SPIN 5.0000E-01 REDUCED NEUTRON WIDTH 2.9230E-03 GAMMA GAMMA 2.4600E-02
NO OF DEGREES OF FREEDOM FOR NEUTRON WIDTH DISTRIBUTION 1
MEAN LEVEL SPACING 9.2500E+00 LEVEL SPIN 1.5000E+00 REDUCED NEUTRON WIDTH 1.4615E-03 GAMMA GAMMA 2.4600E-02
NO OF DEGREES OF FREEDOM FOR NEUTRON WIDTH DISTRIBUTION 1
NUCLEAR RADIUS A=(1.23*MASS**1/3+0.8)*0.1 = 8.4230E-01
AVERAGE SCATTERING AND CAPTURE CROSS-SECTIONS FOR A NON-FISSILE NUCLEUS
TITLE AVERAGE3 TEST,U-238DATA
ENERGY LIMITS LOWER 1.0000E+03 UPPER 1.0000E+05
AVERAGE CROSS-SECTIONS CALCULTED USING GREEBLER APPROXIMATION

NEUTRON ENERGY(EV)	S-WAVE SCATRNG CROSS-SECTION	P-WAVE SCATRNG CROSS-SECTION	TOTAL
1.000000E+03	2.014256E+01	4.648083E-03	2.014721E+01
2.000000E+03	1.764964E+01	1.744892E-02	1.766709E+01
3.000000E+03	1.644058E+01	3.647962E-02	1.647706E+01
4.000000E+03	1.567848E+01	5.999283E-02	1.573847E+01
5.000000E+03	1.513575E+01	8.659303E-02	1.522235E+01
6.000000E+03	1.472052E+01	1.152270E-01	1.483574E+01
7.000000E+03	1.438738E+01	1.451215E-01	1.453250E+01
8.000000E+03	1.411092E+01	1.757174E-01	1.428663E+01
9.000000E+03	1.387560E+01	2.066137E-01	1.408222E+01
1.000000E+04	1.367133E+01	2.375251E-01	1.390886E+01
1.100000E+04	1.349119E+01	2.682505E-01	1.375944E+01
1.200000E+04	1.333027E+01	2.986493E-01	1.362892E+01
1.300000E+04	1.318497E+01	3.286254E-01	1.351359E+01
1.400000E+04	1.305258E+01	3.581147E-01	1.341069E+01
1.500000E+04	1.293100E+01	3.870764E-01	1.331808E+01
1.600000E+04	1.281862E+01	4.154869E-01	1.323411E+01
1.700000E+04	1.271411E+01	4.433347E-01	1.315745E+01
1.800000E+04	1.261643E+01	4.706171E-01	1.308705E+01
1.900000E+04	1.252471E+01	4.973383E-01	1.302205E+01
2.000000E+04	1.243823E+01	5.235065E-01	1.296174E+01
2.100000E+04	1.235641E+01	5.491333E-01	1.290554E+01
2.200000E+04	1.227872E+01	5.742326E-01	1.285295E+01
2.300000E+04	1.220474E+01	5.988195E-01	1.280356E+01
2.400000E+04	1.213411E+01	6.229101E-01	1.275702E+01
2.500000E+04	1.206650E+01	6.465207E-01	1.271302E+01
2.600000E+04	1.200164E+01	6.696681E-01	1.267131E+01
2.700000E+04	1.193929E+01	6.923688E-01	1.263166E+01

2.800000E+04	1.187924E+01	7.146391E-01	1.259388E+01
2.900000E+04	1.182129E+01	7.364949E-01	1.255779E+01
3.000000E+04	1.176529E+01	7.579516E-01	1.252324E+01
3.100000E+04	1.171108E+01	7.790243E-01	1.249010E+01
3.200000E+04	1.165854E+01	7.997275E-01	1.245826E+01
3.300000E+04	1.160754E+01	8.200751E-01	1.242761E+01
3.400000E+04	1.155798E+01	8.400803E-01	1.239806E+01
3.500000E+04	1.150977E+01	8.597562E-01	1.236952E+01
3.600000E+04	1.146281E+01	8.791149E-01	1.234193E+01
3.700000E+04	1.141703E+01	8.981682E-01	1.231520E+01
3.800000E+04	1.137236E+01	9.169274E-01	1.228929E+01
3.900000E+04	1.132873E+01	9.354032E-01	1.226413E+01
4.000000E+04	1.128608E+01	9.536058E-01	1.223968E+01
4.100000E+04	1.124435E+01	9.715452E-01	1.221590E+01
4.200000E+04	1.120350E+01	9.892306E-01	1.219273E+01
4.300000E+04	1.116348E+01	1.006671E+00	1.217015E+01
4.400000E+04	1.112424E+01	1.023875E+00	1.214812E+01
4.500000E+04	1.108575E+01	1.040850E+00	1.212660E+01
4.600000E+04	1.104797E+01	1.057606E+00	1.210557E+01
4.700000E+04	1.101086E+01	1.074148E+00	1.208501E+01
4.800000E+04	1.097439E+01	1.090484E+00	1.206488E+01
4.900000E+04	1.093854E+01	1.106620E+00	1.204516E+01
5.000000E+04	1.090328E+01	1.122565E+00	1.202584E+01
5.100000E+04	1.086857E+01	1.138322E+00	1.200689E+01
5.200000E+04	1.083439E+01	1.153900E+00	1.198829E+01
5.300000E+04	1.080074E+01	1.169302E+00	1.197004E+01
5.400000E+04	1.076757E+01	1.184535E+00	1.195210E+01
5.500000E+04	1.073487E+01	1.199604E+00	1.193448E+01
5.600000E+04	1.070263E+01	1.214514E+00	1.191714E+01
5.700000E+04	1.067082E+01	1.229270E+00	1.190009E+01
5.800000E+04	1.063943E+01	1.243876E+00	1.188331E+01
5.900000E+04	1.060844E+01	1.258336E+00	1.186678E+01
6.000000E+04	1.057785E+01	1.272655E+00	1.185050E+01
6.100000E+04	1.054762E+01	1.286837E+00	1.183446E+01
6.200000E+04	1.051776E+01	1.300886E+00	1.181865E+01
6.300000E+04	1.048825E+01	1.314806E+00	1.180305E+01
6.400000E+04	1.045907E+01	1.328599E+00	1.178767E+01
6.500000E+04	1.043022E+01	1.342270E+00	1.177249E+01
6.600000E+04	1.040169E+01	1.355822E+00	1.175751E+01
6.700000E+04	1.037346E+01	1.369258E+00	1.174272E+01
6.800000E+04	1.034552E+01	1.382581E+00	1.172810E+01
6.900000E+04	1.031787E+01	1.395794E+00	1.171367E+01
7.000000E+04	1.029050E+01	1.408900E+00	1.169940E+01
7.100000E+04	1.026340E+01	1.421901E+00	1.168530E+01
7.200000E+04	1.023656E+01	1.434801E+00	1.167136E+01
7.300000E+04	1.020997E+01	1.447601E+00	1.165757E+01
7.400000E+04	1.018363E+01	1.460304E+00	1.164393E+01
7.500000E+04	1.015753E+01	1.472913E+00	1.163044E+01
7.600000E+04	1.013166E+01	1.485430E+00	1.161709E+01
7.700000E+04	1.010601E+01	1.497856E+00	1.160387E+01
7.800000E+04	1.008059E+01	1.510195E+00	1.159079E+01
7.900000E+04	1.005538E+01	1.522447E+00	1.157783E+01
8.000000E+04	1.003039E+01	1.534616E+00	1.156500E+01
8.100000E+04	1.000559E+01	1.546702E+00	1.155229E+01
8.200000E+04	9.980994E+00	1.558708E+00	1.153970E+01
8.300000E+04	9.956592E+00	1.570636E+00	1.152723E+01
8.400000E+04	9.932377E+00	1.582486E+00	1.151486E+01
8.500000E+04	9.908347E+00	1.594262E+00	1.150261E+01
8.600000E+04	9.884498E+00	1.605963E+00	1.149046E+01
8.700000E+04	9.860824E+00	1.617593E+00	1.147842E+01
8.800000E+04	9.837322E+00	1.629152E+00	1.146647E+01

8.900000E+04	9.813988E+00	1.640642E+00	1.145463E+01
9.000000E+04	9.790817E+00	1.652064E+00	1.144288E+01
9.100000E+04	9.767808E+00	1.663419E+00	1.143123E+01
9.200000E+04	9.744955E+00	1.674709E+00	1.141966E+01
9.300000E+04	9.722257E+00	1.685936E+00	1.140819E+01
9.400000E+04	9.699708E+00	1.697100E+00	1.139681E+01
9.500000E+04	9.677307E+00	1.708202E+00	1.138551E+01
9.600000E+04	9.655050E+00	1.719244E+00	1.137429E+01
9.700000E+04	9.632934E+00	1.730226E+00	1.136316E+01
9.800000E+04	9.610957E+00	1.741150E+00	1.135211E+01
9.900000E+04	9.589115E+00	1.752017E+00	1.134113E+01
1.000000E+05	9.567407E+00	1.762828E+00	1.133023E+01

NEUTRON ENERGY(EV)	S-WAVE CAPTURE CROSS-SECTION	P-WAVE CAPTURE CROSS-SECTION	TOTAL
1.000000E+03	2.602705E+00	2.045669E-01	2.807272E+00
2.000000E+03	1.450008E+00	2.775752E-01	1.727583E+00
3.000000E+03	1.022994E+00	3.238675E-01	1.346861E+00
4.000000E+03	7.964915E-01	3.550220E-01	1.151513E+00
5.000000E+03	6.549666E-01	3.762565E-01	1.031223E+00
6.000000E+03	5.576891E-01	3.905912E-01	9.482803E-01
7.000000E+03	4.864937E-01	3.999717E-01	8.864654E-01
8.000000E+03	4.320128E-01	4.057238E-01	8.377366E-01
9.000000E+03	3.889101E-01	4.087823E-01	7.976924E-01
1.000000E+04	3.539154E-01	4.098224E-01	7.637378E-01
1.100000E+04	3.249098E-01	4.093407E-01	7.342505E-01
1.200000E+04	3.004580E-01	4.077075E-01	7.081655E-01
1.300000E+04	2.795524E-01	4.052024E-01	6.847548E-01
1.400000E+04	2.614641E-01	4.020384E-01	6.635024E-01
1.500000E+04	2.456523E-01	3.983793E-01	6.440316E-01
1.600000E+04	2.317074E-01	3.943520E-01	6.260594E-01
1.700000E+04	2.193130E-01	3.900552E-01	6.093682E-01
1.800000E+04	2.082209E-01	3.855662E-01	5.937872E-01
1.900000E+04	1.982336E-01	3.809460E-01	5.791795E-01
2.000000E+04	1.891916E-01	3.762422E-01	5.654338E-01
2.100000E+04	1.809653E-01	3.714927E-01	5.524579E-01
2.200000E+04	1.734476E-01	3.667273E-01	5.401749E-01
2.300000E+04	1.665495E-01	3.619697E-01	5.285192E-01
2.400000E+04	1.601967E-01	3.572384E-01	5.174351E-01
2.500000E+04	1.543261E-01	3.525480E-01	5.068741E-01
2.600000E+04	1.488841E-01	3.479098E-01	4.967939E-01
2.700000E+04	1.438249E-01	3.433327E-01	4.871576E-01
2.800000E+04	1.391089E-01	3.388234E-01	4.779323E-01
2.900000E+04	1.347020E-01	3.343868E-01	4.690888E-01
3.000000E+04	1.305743E-01	3.300268E-01	4.606011E-01
3.100000E+04	1.266999E-01	3.257457E-01	4.524457E-01
3.200000E+04	1.230558E-01	3.215455E-01	4.446013E-01
3.300000E+04	1.196219E-01	3.174269E-01	4.370488E-01
3.400000E+04	1.163802E-01	3.133903E-01	4.297705E-01
3.500000E+04	1.133149E-01	3.094358E-01	4.227507E-01
3.600000E+04	1.104117E-01	3.055628E-01	4.159745E-01
3.700000E+04	1.076580E-01	3.017705E-01	4.094285E-01
3.800000E+04	1.050424E-01	2.980579E-01	4.031004E-01
3.900000E+04	1.025547E-01	2.944239E-01	3.969786E-01
4.000000E+04	1.001855E-01	2.908670E-01	3.910526E-01
4.100000E+04	9.792659E-02	2.873859E-01	3.853125E-01
4.200000E+04	9.577024E-02	2.839790E-01	3.797492E-01
4.300000E+04	9.370956E-02	2.806446E-01	3.743542E-01
4.400000E+04	9.173827E-02	2.773812E-01	3.691195E-01
4.500000E+04	8.985060E-02	2.741871E-01	3.640377E-01

4.600000E+04	8.804128E-02	2.710607E-01	3.591020E-01
4.700000E+04	8.630548E-02	2.680001E-01	3.543056E-01
4.800000E+04	8.463876E-02	2.650039E-01	3.496427E-01
4.900000E+04	8.303701E-02	2.620703E-01	3.451073E-01
5.000000E+04	8.149648E-02	2.591977E-01	3.406942E-01
5.100000E+04	8.001369E-02	2.563846E-01	3.363983E-01
5.200000E+04	7.858540E-02	2.536293E-01	3.322147E-01
5.300000E+04	7.720864E-02	2.509303E-01	3.281389E-01
5.400000E+04	7.588064E-02	2.482861E-01	3.241667E-01
5.500000E+04	7.459881E-02	2.456952E-01	3.202940E-01
5.600000E+04	7.336078E-02	2.431563E-01	3.165170E-01
5.700000E+04	7.216430E-02	2.406678E-01	3.128321E-01
5.800000E+04	7.100729E-02	2.382285E-01	3.092358E-01
5.900000E+04	6.988782E-02	2.358370E-01	3.057248E-01
6.000000E+04	6.880407E-02	2.334921E-01	3.022961E-01
6.100000E+04	6.775433E-02	2.311924E-01	2.989467E-01
6.200000E+04	6.673701E-02	2.289369E-01	2.956739E-01
6.300000E+04	6.575061E-02	2.267242E-01	2.924748E-01
6.400000E+04	6.479374E-02	2.245533E-01	2.893471E-01
6.500000E+04	6.386507E-02	2.224231E-01	2.862882E-01
6.600000E+04	6.296335E-02	2.203325E-01	2.832959E-01
6.700000E+04	6.208743E-02	2.182805E-01	2.803679E-01
6.800000E+04	6.123619E-02	2.162660E-01	2.775021E-01
6.900000E+04	6.040860E-02	2.142880E-01	2.746966E-01
7.000000E+04	5.960367E-02	2.123457E-01	2.719494E-01
7.100000E+04	5.882049E-02	2.104381E-01	2.692586E-01
7.200000E+04	5.805815E-02	2.085644E-01	2.666225E-01
7.300000E+04	5.731585E-02	2.067236E-01	2.640394E-01
7.400000E+04	5.659278E-02	2.049149E-01	2.615077E-01
7.500000E+04	5.588821E-02	2.031376E-01	2.590258E-01
7.600000E+04	5.520143E-02	2.013908E-01	2.565922E-01
7.700000E+04	5.453176E-02	1.996738E-01	2.542055E-01
7.800000E+04	5.387856E-02	1.979858E-01	2.518644E-01
7.900000E+04	5.324123E-02	1.963262E-01	2.495674E-01
8.000000E+04	5.261919E-02	1.946942E-01	2.473134E-01
8.100000E+04	5.201190E-02	1.930892E-01	2.451011E-01
8.200000E+04	5.141882E-02	1.915106E-01	2.429294E-01
8.300000E+04	5.083946E-02	1.899576E-01	2.407971E-01
8.400000E+04	5.027335E-02	1.884297E-01	2.387031E-01
8.500000E+04	4.972002E-02	1.869264E-01	2.366464E-01
8.600000E+04	4.917906E-02	1.854469E-01	2.346260E-01
8.700000E+04	4.865003E-02	1.839908E-01	2.326409E-01
8.800000E+04	4.813256E-02	1.825576E-01	2.306901E-01
8.900000E+04	4.762626E-02	1.811466E-01	2.287729E-01
9.000000E+04	4.713076E-02	1.797574E-01	2.268882E-01
9.100000E+04	4.664573E-02	1.783896E-01	2.250353E-01
9.200000E+04	4.617083E-02	1.770425E-01	2.232134E-01
9.300000E+04	4.570575E-02	1.757158E-01	2.214216E-01
9.400000E+04	4.525018E-02	1.744090E-01	2.196592E-01
9.500000E+04	4.480382E-02	1.731217E-01	2.179255E-01
9.600000E+04	4.436640E-02	1.718534E-01	2.162198E-01
9.700000E+04	4.393766E-02	1.706037E-01	2.145413E-01
9.800000E+04	4.351732E-02	1.693722E-01	2.128895E-01
9.900000E+04	4.310516E-02	1.681585E-01	2.112637E-01
1.000000E+05	4.270091E-02	1.669623E-01	2.096633E-01

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 PROGRAM AVRAGE3, CALCULATES CROSS-SECTIONS IN THE UNRESOLVED RESONANCE REGION.


ENDF/B VERSION II DATA WITH ENERGY INDEPENDENT PARAMETERS.


RUN NO    3  TITLE   AVERAGE3 TEST. U-235 DATA     EO 0.000000E+00  EN 0.000000E+00  ESTEP 0.000000E+00
ENERGY LIMITS LOWER        6.450400E+01  UPPER         5.000000E+04   LRU=    2   LRF=    1   LFI=    0
TARGET SPIN 3.5000E+00 SCATTERING LENGTH 8.3668E-01 NO OF ENERGY VALUES AT WHICH FISSION WIDTHS ARE GIVEN   25
DATA FOR A FISSILE NUCLEUS


S-WAVE DATA


FISSION WIDTHS ARE GIVEN AT THE FOLLOWING ENERGIES
6.4504E+01 8.2000E+01 1.2500E+02 1.7500E+02 2.2500E+02 2.7500E+02
3.5000E+02 4.5000E+02 6.0000E+02 8.5000E+02 1.2500E+03 1.7500E+03
2.5000E+03 3.5000E+03 4.5000E+03 5.5000E+03 7.0000E+03 9.0000E+03
1.2500E+04 1.7500E+04 2.2500E+04 2.7500E+04 3.5000E+04 4.5000E+04
5.0000E+04
ISOTOPIC MASS 2.3302E+02 ANGULAR MOMENTUM    0 NO OF SPIN STATES    2


MEAN LEVEL SPACING 1.0000E+00 LEVEL SPIN 3.0000E+00 REDUCED NEUTRON WIDTH 1.0000E-04 GAMMA GAMMA 3.5000E-02
NO OF DEGREES OF FREEDOM FOR NEUTRON WIDTH DISTRIBUTION      1
NO OF DEGREES OF FREEDOM FOR FISSION WIDTH DISTRIBUTION      2
THE FISSION WIDTHS ARE
2.9474E-01 2.9264E-01 2.4623E-01 2.4258E-01 2.6413E-01 4.9705E-01
2.7310E-01 4.5109E-01 4.4004E-01 2.3327E-01 3.0220E-01 3.5300E-01
4.2449E-01 3.2358E-01 3.2196E-01 3.2284E-01 3.3009E-01 3.3291E-01
4.3837E-01 4.3870E-01 4.5035E-01 4.7280E-01 5.2078E-01 5.9992E-01
5.7033E-01


MEAN LEVEL SPACING 1.0000E+00 LEVEL SPIN 4.0000E+00 REDUCED NEUTRON WIDTH 1.0000E-04 GAMMA GAMMA 3.5000E-02
NO OF DEGREES OF FREEDOM FOR NEUTRON WIDTH DISTRIBUTION      1
NO OF DEGREES OF FREEDOM FOR FISSION WIDTH DISTRIBUTION      1
THE FISSION WIDTHS ARE
1.4737E-01 1.4632E-01 1.2311E-01 1.2129E-01 1.3207E-01 2.4852E-01
1.3655E-01 2.2554E-01 2.2002E-01 1.1663E-01 1.5110E-01 1.7650E-01
2.1225E-01 1.6179E-01 1.6098E-01 1.6142E-01 1.6505E-01 1.6646E-01
2.1918E-01 2.1935E-01 2.2517E-01 2.3640E-01 2.6039E-01 2.9996E-01
2.8517E-01


P-WAVE DATA


ISOTOPIC MASS 2.3302E+02 ANGULAR MOMENTUM    1 NO OF SPIN STATES    4
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MEAN LEVEL SPACING 1.1600E+00 LEVEL SPIN 2.0000E+00 REDUCED NEUTRON WIDTH 2.3200E-04 GAMMA GAMMA 3.5000E-02
NO OF DEGREES OF FREEDOM FOR NEUTRON WIDTH DISTRIBUTION      1
NO OF DEGREES OF FREEDOM FOR FISSION WIDTH DISTRIBUTION      2
THE FISSION WIDTHS ARE
3.3200E-01 3.3200E-01 3.3200E-01 3.3200E-01 3.3200E-01 3.3200E-01
3.3200E-01 3.3200E-01 3.3200E-01 3.3200E-01 3.3200E-01 3.3200E-01
3.3200E-01 3.3200E-01 3.3200E-01 3.3200E-01 3.3200E-01 3.3200E-01
3.3200E-01 3.3200E-01 3.3200E-01 3.3200E-01 3.3200E-01 3.3200E-01
3.3200E-01


MEAN LEVEL SPACING 1.0000E+00 LEVEL SPIN 3.0000E+00 REDUCED NEUTRON WIDTH 2.0000E-04 GAMMA GAMMA 3.5000E-02
NO OF DEGREES OF FREEDOM FOR NEUTRON WIDTH DISTRIBUTION      2
NO OF DEGREES OF FREEDOM FOR FISSION WIDTH DISTRIBUTION      1
THE FISSION WIDTHS ARE
1.2700E-01 1.2700E-01 1.2700E-01 1.2700E-01 1.2700E-01 1.2700E-01
1.2700E-01 1.2700E-01 1.2700E-01 1.2700E-01 1.2700E-01 1.2700E-01
1.2700E-01 1.2700E-01 1.2700E-01 1.2700E-01 1.2700E-01 1.2700E-01
1.2700E-01 1.2700E-01 1.2700E-01 1.2700E-01 1.2700E-01 1.2700E-01
1.2700E-01


MEAN LEVEL SPACING 1.0000E+00 LEVEL SPIN 4.0000E+00 REDUCED NEUTRON WIDTH 2.0000E-04 GAMMA GAMMA 3.5000E-02
NO OF DEGREES OF FREEDOM FOR NEUTRON WIDTH DISTRIBUTION      2
NO OF DEGREES OF FREEDOM FOR FISSION WIDTH DISTRIBUTION      2
THE FISSION WIDTHS ARE
2.8600E-01 2.8600E-01 2.8600E-01 2.8600E-01 2.8600E-01 2.8600E-01
2.8600E-01 2.8600E-01 2.8600E-01 2.8600E-01 2.8600E-01 2.8600E-01
2.8600E-01 2.8600E-01 2.8600E-01 2.8600E-01 2.8600E-01 2.8600E-01
2.8600E-01 2.8600E-01 2.8600E-01 2.8600E-01 2.8600E-01 2.8600E-01
2.8600E-01


MEAN LEVEL SPACING 1.1200E+00 LEVEL SPIN 5.0000E+00 REDUCED NEUTRON WIDTH 2.2400E-04 GAMMA GAMMA 3.5000E-02
NO OF DEGREES OF FREEDOM FOR NEUTRON WIDTH DISTRIBUTION      1
NO OF DEGREES OF FREEDOM FOR FISSION WIDTH DISTRIBUTION      1
THE FISSION WIDTHS ARE
1.4300E-01 1.4300E-01 1.4300E-01 1.4300E-01 1.4300E-01 1.4300E-01
1.4300E-01 1.4300E-01 1.4300E-01 1.4300E-01 1.4300E-01 1.4300E-01
1.4300E-01 1.4300E-01 1.4300E-01 1.4300E-01 1.4300E-01 1.4300E-01
1.4300E-01 1.4300E-01 1.4300E-01 1.4300E-01 1.4300E-01 1.4300E-01
1.4300E-01
NUCLEAR RADIUS A=(1.23*MASS**1/3+0.8)*0.1    = 8.3908E-01
AVERAGE SCATTERING CAPTURE AND FISSION CROSS-SECTIONS FOR A FISSILE NUCLEUS
TITLE     AVERAGE3 TEST, U-235 DATA
AVERAGE CROSS-SECTIONS CALCULTED USING GREEBLER APPROXIMATION
NEUTRON ENERGY(EV)      S-WAVE SCATRNG CROSS-SECTION      P-WAVE SCATRNG CROSS-SECTION      TOTAL
    6.450400E+01              9.788764E+00                  9.226386E-07                  9.788764E+00
    8.200000E+01              9.783050E+00                  1.490894E-06                  9.783051E+00
    1.250000E+02              9.837830E+00                  3.463224E-06                  9.837833E+00
    1.750000E+02              9.826114E+00                  6.785592E-06                  9.826121E+00
    2.250000E+02              9.775332E+00                  1.121284E-05                  9.775343E+00
    2.750000E+02              9.523842E+00                  1.674392E-05                  9.523858E+00
    3.500000E+02              9.731142E+00                  2.710691E-05                  9.731169E+00
    4.500000E+02              9.525672E+00                  4.477498E-05                  9.525717E+00
    6.000000E+02              9.511716E+00                  7.950534E-05                  9.511795E+00
    8.500000E+02              9.708309E+00                  1.592398E-04                  9.708468E+00
    1.250000E+03              9.565566E+00                  3.432135E-04                  9.565909E+00
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1.750000E+03	9.467040E+00	6.697206E-04	9.467710E+00
2.500000E+03	9.354840E+00	1.357264E-03	9.356197E+00
3.500000E+03	9.376833E+00	2.634245E-03	9.379467E+00
4.500000E+03	9.325037E+00	4.310002E-03	9.329347E+00
5.500000E+03	9.276947E+00	6.370052E-03	9.283317E+00
7.000000E+03	9.207707E+00	1.014860E-02	9.217856E+00
9.000000E+03	9.131466E+00	1.639498E-02	9.147881E+00
1.250000E+04	8.953983E+00	3.032915E-02	8.984312E+00
1.750000E+04	8.821273E+00	5.588043E-02	8.877153E+00
2.250000E+04	8.698854E+00	8.676379E-02	8.785617E+00
2.750000E+04	8.582843E+00	1.217690E-01	8.704612E+00
3.500000E+04	8.419337E+00	1.799386E-01	8.599276E+00
4.500000E+04	8.219320E+00	2.644437E-01	8.483764E+00
5.000000E+04	8.144976E+00	3.085493E-01	8.453526E+00

NEUTRON ENERGY(EV)	S-WAVE CAPTURE CROSS-SECTION	P-WAVE CAPTURE CROSS-SECTION	TOTAL
6.450400E+01	1.670961E+01	2.245335E-02	1.673206E+01
8.200000E+01	1.480249E+01	2.531427E-02	1.482780E+01
1.250000E+02	1.275553E+01	3.124925E-02	1.278678E+01
1.750000E+02	1.075604E+01	3.696708E-02	1.079301E+01
2.250000E+02	9.102775E+00	4.190795E-02	9.144683E+00
2.750000E+02	6.249314E+00	4.632106E-02	6.295635E+00
3.500000E+02	7.099218E+00	5.224000E-02	7.151458E+00
4.500000E+02	5.017959E+00	5.920781E-02	5.077167E+00
6.000000E+02	4.344129E+00	6.831923E-02	4.412448E+00
8.500000E+02	4.670069E+00	8.121629E-02	4.751285E+00
1.250000E+03	3.401904E+00	9.828374E-02	3.500267E+00
1.750000E+03	2.642962E+00	1.159675E-01	2.758929E+00
2.500000E+03	1.997828E+00	1.379888E-01	2.135816E+00
3.500000E+03	1.841602E+00	1.622263E-01	2.003828E+00
4.500000E+03	1.592930E+00	1.826941E-01	1.775625E+00
5.500000E+03	1.413095E+00	2.005299E-01	1.613625E+00
7.000000E+03	1.212624E+00	2.236819E-01	1.436306E+00
9.000000E+03	1.038101E+00	2.496294E-01	1.287730E+00
1.250000E+04	7.600101E-01	2.856517E-01	1.045662E+00
1.750000E+04	6.166210E-01	3.233384E-01	9.399593E-01
2.250000E+04	5.208346E-01	3.502874E-01	8.711220E-01
2.750000E+04	4.494779E-01	3.698578E-01	8.193356E-01
3.500000E+04	3.701678E-01	3.896464E-01	7.598143E-01
4.500000E+04	2.967705E-01	4.042575E-01	7.010280E-01
5.000000E+04	2.828520E-01	4.081669E-01	6.910168E-01

NEUTRON ENERGY(EV)	S-WAVE FISSION CROSS-SECTION	P-WAVE NEUTRON CROSS-SECTION	TOTAL
6.450400E+01	3.363107E+01	4.449157E-02	3.367556E+01
8.200000E+01	2.973384E+01	5.016079E-02	2.978400E+01
1.250000E+02	2.306274E+01	6.192206E-02	2.312466E+01
1.750000E+02	1.935532E+01	7.325386E-02	1.942857E+01
2.250000E+02	1.737230E+01	8.304681E-02	1.745534E+01
2.750000E+02	1.784734E+01	9.179468E-02	1.793913E+01
3.500000E+02	1.395819E+01	1.035292E-01	1.406172E+01
4.500000E+02	1.363367E+01	1.173465E-01	1.375102E+01
6.000000E+02	1.170601E+01	1.354217E-01	1.184143E+01
8.500000E+02	8.476841E+00	1.610252E-01	8.637866E+00
1.250000E+03	7.385552E+00	1.949551E-01	7.580507E+00
1.750000E+03	6.413942E+00	2.301918E-01	6.644134E+00
2.500000E+03	5.531043E+00	2.742395E-01	5.805282E+00
3.500000E+03	4.353070E+00	3.230284E-01	4.676098E+00
4.500000E+03	3.798900E+00	3.645792E-01	4.163479E+00
5.500000E+03	3.412830E+00	4.011337E-01	3.811963E+00
7.000000E+03	3.008405E+00	4.492115E-01	3.457617E+00

9.000000E+03	2.627382E+00	5.042107E-01	3.131593E+00
1.250000E+04	2.345241E+00	5.533680E-01	2.928609E+00
1.750000E+04	1.947829E+00	6.716611E-01	2.619490E+00
2.250000E+04	1.703901E+00	7.405824E-01	2.444483E+00
2.750000E+04	1.540581E+00	7.958978E-01	2.336479E+00
3.500000E+04	1.376495E+00	8.604654E-01	2.236960E+00
4.500000E+04	1.234570E+00	9.222714E-01	2.156841E+00
5.000000E+04	1.149153E+00	9.455514E-01	2.094705E+00

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C     PROGRAM AVRAGE4(INPUT,OUTPUT)                                          AVG4001
C----=-THIS PROGRAM CALCULATES AVERAGE CAPTURE,FISSION AND SCATTERING         AVG4002
C-----CROSS-SECTIONS FROM THE ENDF/B DATA. NEW FORMAT FOR INPUT. THIS         AVG4003
C-----FORMAT GIVES THE NEUTRON,CAPTURE AND FISSION WIDTHS AS A FUNCTION      AVG4004
C-----OF ENERGY.THIS IS FORMAT MODIFICATION NO.69-6 OF SEPT. 1969.           AVG4005
C-----ENDF/B VERSION II DATA,RUNS ON CDC-6600 AND PDP-10.                    AVG4006
C-----LIMITATIONS-=--- 1.CALCULATES S,P AND D-WAVE CONTRIBUTIONS ONLY.       AVG4007
C----=-2.INELASTIC EFFECTS     ALLOWED FOR.3.WIDTH FLUCTUATIONS OF UPTO      AVG4008
C----=-4 DEGREES OF FREEDOM ARE ALLOWED FOR NEUTRON,FISSION AND INELASTICAVG4009
C----=-WIDTHS.                                                              AVG4010
      DIMENSION RUN(7),BLA(20),E(3,6, 75),D(3,6, 75),GX(3,6, 75),           AVG4011
     1GNO(3,6, 75),GG(3,6, 75),GF(3,6, 75),AMUX(3,6),AMUN(3,6),AMUG(3,6)AVG4012
     2,AMUF(3,6),AJ(3,6),NE(3,6),NJS(3),L(3),INTS(3,6),SIGC(3,6, 75),       AVG4013
     3SIGS(3,6, 75),SIGF(3,6, 75),SIGCT(3, 75),SIGST(3, 75),SIGFT(3, 75)AVG4014
     4,SIGPT(3, 75),GTC(3,6, 75)                                            AVG4015
      COMMON/XBAR/XX(4,10)                                                  AVG4016
      DATA XX/0.005252,0.051755,0.112925,0.169150,0.037171,0.163095,        AVG4017
     10.265600,0.340780,0.103126,0.288421,0.404385,0.480571,0.207836,       AVG4018
     20.431766,0.547724,0.617825,0.359852,0.599210,0.704048,0.762381,       AVG4019
     30.574283,0.800560,0.882440,0.922898,0.879334,1.053224,1.096835,       AVG4020
     41.111387,1.334810,1.393010,1.374373,1.350285,2.105227,1.916230,       AVG4021
     51.786357,1.697511,4.390800,3.301643,2.824583,2.546602/                AVG4022
C----=1111111111111111111111111111111111111111111111111111111111111111AVG4023
  881              READ1,IRUN,(RUN(I),I=1,7)                                AVG4024
      IF(IRUN.EQ.0)GO TO 8800                                               AVG4025
      GO TO 882                                                             AVG40251
  882               PRINT43                                                 AVG4026
                    PRINT25                                                 AVG4027
                    PRINT44                                                 AVG4028
                    PRINT25                                                 AVG4029
                    PRINT27,IRUN,(RUN(I),I=1,7)                             AVG4030
                    PRINT25                                                 AVG4031
C-----IF IRUN EQUALS ZERO THE PROGRAM EXITS. WITH IRUN NON-ZERO ONE CAN     AVG4032
C----=-STACK ANY NUMBER OF DIFFERENT NUCLEI ONE BEHIND ANOTHER. RUN(1) TOAVG4033
C-----RUN(7) ANY TITLE IN COLUMNS 11 TO 38.                                 AVG4034
C----=-2222222222222222222222222222222222222222222222222222222222222222AVG4035
                    READ 2,EN1,EN2,LRU,LRF                                  AVG4036
                   PRINT26,EN1,EN2,LRU,LRF                                  AVG4037
                    PRINT25                                                 AVG4038
C-----EN1=LOWER ENERGY LIMIT OF A RANGE,EN2=UPPER LIMIT. LRU=1 IMPLIES      AVG4039
C-----RESOLVED PARAMETERS,LRU=2 UNRESOLVED PARAMETERS.                      AVG4040
C----=-3333333333333333333333333333333333333333333333333333333333333333AVG4041
                    READ2,SPIN,A,BLA(2),BLA(3),NLS,BLA(4)                   AVG4042
                    PRINT28,SPIN,A,NLS                                      AVG4043
C----=-SPIN=NUCLEAR SPIN. A=SCATTERING LENGTH IN UNITS OF 1.0E-12CM.        AVG4044
C-----NLS=NUMBER OF L-STATES.                                               AVG4045
      DO 200 I=1,NLS                                                        AVG4046
C-----444444444444444444444444444444444444444444444444444444444444444AVG4047
                    READ2,AWRI,BLA(5),L(I),BLA(6),NJS(I)                    AVG4048
      ASS=AWRI*1.008665                                                     AVG4049
      CRT=ASS**(1.0/3.0)                                                    AVG4050
      TERM=(0.123*CRT+0.08)                                                 AVG4051
      APEN=TERM                                                             AVG4052
                    PRINT25                                                 AVG4053
                    PRINT23,APEN                                            AVG4054
                    PRINT25                                                 AVG4055
                    PRINT29,AWRI,L(I),NJS(I)                                AVG4056
C----=-AWRI=NUCLEAR MASS IN UNITS OF NEUTRON MASS,L(I)=L-VALUE OF THE I-    AVG4057
C----=TH PARTIAL WAVE.NJS(I)=NUMBER OF J-VALUES OF THE CORRESPONDING STAAVG4058
C-----TE.                                                                   AVG4059
      NJSI=NJS(I)                                                           AVG4060
```

```
      DO 201 J=1,NJSI                                                   AVG4061
C---=-555555555555555555555555555555555555555555555555555555555555555AVG4062
                  READ2,AJ(I,J),BLA(7),INTS(I,J),BLA(8),NEX6,NE(I,J)    AVG4063
                  PRINT25                                               AVG4064
                  PRINT30,AJ(I,J),INTS(I,J),NE(I,J)                     AVG4065
C-----AJ(I,J)=J-VALUE,INTS(I,J)=INTERPOLATION CODE, NE(I,J)=NUMBER OF   AVG4066
C-----ENERGY POINTS AT WHICH THE WIDTHS ARE GIVEN,                      AVG4067
C-----6666666666666666666666666666666666666666666666666666666666666666AVG4068
                  READ3,BLA(9),BLA(10),AMUX(I,J),AMUN(I,J),AMUG(I,J),   AVG4069
     1            AMUF(I,J)                                             AVG4070
                  PRINT31,AMUX(I,J),AMUN(I,J),AMUG(I,J),AMUF(I,J)       AVG4071
C-----AMUX(I,J)=NUMBER OF DEGREES OF FREEDOM FOR ANY COMPETING INELASTICAVG4072
C-----PROCESSES,                                                        AVG4073
C-----AMUN(I,J)=NUMBER OF DEGREES OF FREEDOM FOR NEUTRON WIDTH DISTRBN, AVG4074
C-----AMUG(I,J)=NUMBER OF DEGREES OF FREEDOM FOR GAMMA WIDTH DISTRBN,   AVG4075
C-----AMUF(I,J)=NUMBER OF DEGREES OF FREEDOM FOR FISSION WIDTH DISTRBN, AVG4076
      NEIJ=NE(I,J)                                                      AVG4077
      DO 202 K=1,NEIJ                                                   AVG4078
C-----777777777777777777777777777777777777777777777777777777777777777AVG4079
                  READ3,E(I,J,K),D(I,J,K),GX(I,J,K),GNO(I,J,K),         AVG4080
     1            GG(I,J,K),GF(I,J,K)                                   AVG4081
  202 CONTINUE                                                          AVG4082
C-----E(I,J,K)=ENERGY IN EV ,D(I,J,K)=SPACING, GX(I,J,K)=WIDTH FOR ANY  AVG4083
C-----COMPETING INELASTIC PROCESSES,                                    AVG4084
C-----GNO(I,J,K)=REDUCED NEUTRON WIDTH, GG(I,J,K)=GAMMA WIDTH,         AVG4085
C-----GF(I,J,K)=FISSION WIDTH,                                          AVG4086
                  PRINT32                                               AVG4087
                  PRINT33,(E(I,J,KK),D(I,J,KK),GX(I,J,KK),GNO(I,J,KK),  AVG4088
     1            GG(I,J,KK),GF(I,J,KK),KK=1,NEIJ)                      AVG4089
  201 CONTINUE                                                          AVG4090
  200 CONTINUE                                                          AVG4091
    1 FORMAT(I10,7A4)                                                   AVG4092
    2 FORMAT(2E11.4,4I11)                                               AVG4093
    3 FORMAT(6E11.4)                                                    AVG4094
   22 FORMAT(106H       ENERGY(EV)       SPACING      GAMMA INELAS   GAMMAAVG4095
     1 TOTAL    GAMMA N NOT     GAMMA GAMMA    GAMMA FISS)              AVG4096
   23 FORMAT(72H NUCLEAR RADIUS'A' AS CALCULATED FROM A=(1.23*(MASS**(1/AVG4097
     13)+0.8)*0.1    =E11.4)                                            AVG4098
   24 FORMAT(2X,5E25.6)                                                 AVG4099
   25 FORMAT(///)                                                       AVG4100
   26 FORMAT(20H ENERGY LIMITS LOWERE20.6,7H  UPPERE20.6,7H   LRU=I5,7H AVG4101
     1  LRF=I5)                                                         AVG4102
   27 FORMAT(7H RUN NOI5,9H  TITLE  7A4)                                AVG4103
   28 FORMAT(12H TARGET SPINE11.4,18H SCATTERING LENGTHE11.4,19H NUMBER AVG4104
     10F L-STATESI10)                                                  AVG4105
   29 FORMAT(26H NUCLEAR MASS/NEUTRON MASSE11.4,18H ANGULAR MOMENTUM I5,AVG4106
     136H NUMBER OF J-STATES FOR THIS L-VALUEI5)                       AVG4107
   30 FORMAT(5H SPINE11.4,19H INTERPOLATION CODEI5,24H NUMBER OF ENERGY AVG4108
     1POINTSI5)                                                        AVG4109
   31 FORMAT(37H DEGREES OF FREEDOM.     NU INELASTICE11.4,16H      NU NAVG4110
     1EUTRONE11.4,14H      NU GAMMAE11.4,16H      NU FISSIONE11.4)     AVG4111
   32 FORMAT(120H            ENERGY(EV)          SPACING          GAMMAAVG4112
     1 INELAS        GAMMA N NOT         GAMMA GAMMA          GAMMAFISS)AVG4113
   33 FORMAT(2X,6E20.6)                                                 AVG4114
   34 FORMAT(124H          NEUTRON ENERGY(EV)         S-WAVE SIGMANN     AVG4115
     1      P-WAVE SIGMANN           D-WAVE SIGMANN           TOTAL SIGMAVG4116
     2ANN)                                                             AVG4117
   35 FORMAT(127H          NEUTRON ENERGY(EV)       S-WAVE SIGMANGAMMA   AVG4118
     1    P-WAVE SIGMANGAMMA       D-WAVE SIGMANGAMMA       TOTAL SIGMAAVG4119
     2NGAMMA)                                                          AVG4120
   36 FORMAT(125H          NEUTRON ENERGY(EV)        S-WAVE SIGMAFISS    AVG4121
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     1     P-WAVE SIGMAFISS          D-WAVE SIGMAFISS          TOTAL SIGMAAVG4122
     2FISS)                                                              AVG4123
  37 FORMAT(33H AVERAGE SCATTERING CROSS-SECTION)                        AVG4124
  38 FORMAT(30H AVERAGE CAPTURE CROSS-SECTION)                           AVG4125
  39 FORMAT(30H AVERAGE FISSION CROSS-SECTION)                           AVG4126
  40 FORMAT(2X,7E15.6)                                                   AVG4127
  41 FORMAT(45H INPUT PARAMETERS WITH CALCULATED TOTAL WIDTH)            AVG4128
  42 FORMAT(10H  L-VALUE=I5,10H  J-STATE=F5.2)                           AVG4129
  43 FORMAT(79H1 PROGRAM AVRAGE4, CALCULATES CROSS-SECTIONS IN THE UNREAVG4130
     1SOLVED RESONANCE REGION)                                           AVG4131
  44 FORMAT(56H ENDF/B VERSION II DATA WITH ENERGY DEPENDENT PARAMETERSAVG4132
     1)                                                                  AVG4133
 300 T=2.196771E-03*(AWRI/(AWRI+1.0))                                   AVG4134
     CONST=19.739208/(T*T)                                              AVG41341
     PHIFOUR=12.56637                                                   AVG4135
     CPEN=2.196771E-03*(AWRI/(AWRI+1.0))*APEN                           AVG4136
     C=2.196771E-03*(AWRI/(AWRI+1.0))*A                                 AVG4137
     DO 403 I=1,3                                                       AVG4138
     DO 405 K=1, 75                                                     AVG4139
     DO 404 J=1,6                                                       AVG4140
     SIGC(I,J,K)=0.0                                                    AVG4141
     SIGS(I,J,K)=0.0                                                    AVG4142
     SIGF(I,J,K)=0.0                                                    AVG4143
     GTC(I,J,K)=0.0                                                     AVG4144
 404 CONTINUE                                                           AVG4145
     SIGCT(I,K)=0.0                                                     AVG4146
     SIGST(I,K)=0.0                                                     AVG4147
     SIGFT(I,K)=0.0                                                     AVG4148
     SIGPT(I,K)=0.0                                                     AVG4149
 405 CONTINUE                                                           AVG4150
 403 CONTINUE                                                           AVG4151
     DO 400 I=1,NLS                                                     AVG4152
     NJSI=NJS(I)                                                        AVG4153
     LI=L(I)                                                            AVG4154
     FIL=FLOAT (LI)                                                     AVG4155
     LII=LI+1                                                           AVG4156
     DO 401 J=1,NJSI                                                    AVG4157
     AJIJ=AJ(I,J)                                                       AVG4158
     NEIJ=NE(I,J)                                                       AVG4159
     GJ=(2.0*AJIJ+1.0)/(4.0*SPIN+2.0)                                   AVG4160
     AMUNIJ=AMUN(I,J)                                                   AVG4161
     AMUFIJ=AMUF(I,J)                                                   AVG4162
     AMUXIJ=AMUX(I,J)                                                   AVG4163
     MU=INT(AMUNIJ)                                                     AVG4164
     NU=INT(AMUFIJ)                                                     AVG4165
     LAMBDA=INT(AMUXIJ)                                                 AVG4166
     DO 402 K=1,NEIJ                                                    AVG4167
     EIJK=E(I,J,K)                                                      AVG4168
     E2=SQRT(EIJK)                                                      AVG4169
     WAVE=2.196771E-03*(AWRI/(AWRI+1.0))*E2                             AVG4170
     RHO=C*E2                                                           AVG4171
     RHOPEN=CPEN*E2                                                     AVG4172
     GO TO(500,501,502),LII                                             AVG4173
 500 VL=E2*AMUN(I,J)                                                    AVG4174
     PS=RHO                                                             AVG4175
     GO TO 503                                                          AVG4176
 501 VL=E2*(RHOPEN**2/(1.0+RHOPEN**2))*AMUN(I,J)                        AVG4177
     PS=RHO-ATAN(RHO)                                                   AVG4178
     GO TO 503                                                          AVG4179
 502 VL=E2*(RHOPEN**4/(RHOPEN**4+3.0*RHOPEN*RHOPEN+9.0))*AMUN(I,J)      AVG4180
     PS=RHO-ATAN(3.0*RHO/(3.0-RHO**2))                                  AVG4181
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 503 SIGPOT=(SIN(PS)/WAVE)**2                                                    AVG4182
     SIGPOT=SIGPOT*PHIFOUR*(2.0*FIL+1.0)                                         AVG4183
     GN=GNO(I,J,K)*VL                                                            AVG4184
     GAMMA=GG(I,J,K)                                                             AVG4185
     GALPHA=GN                                                                   AVG4186
     GBETA=GF(I,J,K)                                                             AVG4187
     DIFF=GX(I,J,K)                                                              AVG4188
     GTC(I,J,K)=GN+GAMMA+GBETA+DIFF                                              AVG4189
 752 TERG=(CONST*GJ*GN*GAMMA)/(EIJK*D(I,J,K))                                    AVG4190
     TERS=(CONST*GJ*GN*GN)/(EIJK*D(I,J,K))                                       AVG4191
     TERF=(CONST*GJ*GN*GBETA)/(EIJK*D(I,J,K))                                    AVG4192
     CALL GNRL(GALPHA,GBETA,GAMMA,MU,NU,LAMBDA,GS,DIFF,1)                        AVG4193
     CALL GNRL(GALPHA,GBETA,GAMMA,MU,NU,LAMBDA,GC,DIFF,2)                        AVG4194
     CALL GNRL(GALPHA,GBETA,GAMMA,MU,NU,LAMBDA,GFF,DIFF,3)                       AVG4195
     GS=GS*TERS                                                                  AVG4196
     GC=GC*TERG                                                                  AVG4197
     GFF=GFF*TERF                                                                AVG4198
     CORR=(CONST*GJ*2.0*GN*SIN(PS)*SIN(PS))/(EIJK*D(I,J,K))                      AVG41981
     GS=GS-CORR                                                                  AVG41982
     SIGC(I,J,K)=GC                                                              AVG4199
     SIGS(I,J,K)=GS                                                              AVG4200
     SIGF(I,J,K)=GFF                                                             AVG4201
     SIGPT(I,K)=SIGPCT                                                           AVG4202
 402 CONTINUE                                                                    AVG4203
 401 CONTINUE                                                                    AVG4204
 400 CONTINUE                                                                    AVG4205
     PRINT25                                                                     AVG4206
     PRINT41                                                                     AVG4207
     PRINT25                                                                     AVG4208
     DO 8000 I=1,NLS                                                             AVG4209
     LII=L(I)                                                                    AVG4210
     NJSI=NJS(I)                                                                 AVG4211
     DO 8001 J=1,NJSI                                                            AVG4212
     AJIJ=AJ(I,J)                                                                AVG4213
     NEIJ=NE(I,J)                                                                AVG4214
     PRINT42,LII,AJIJ                                                            AVG4215
     PRINT25                                                                     AVG4216
     PRINT22                                                                     AVG4217
     PRINT40,(E(I,J,KK),D(I,J,KK),GX(I,J,KK),GTC(I,J,KK),GNO(I,J,KK),           AVG4218
    1GG(I,J,KK),GF(I,J,KK),KK=1,NEIJ)                                           AVG4219
8001 CONTINUE                                                                    AVG4220
8000 CONTINUE                                                                    AVG4221
     DO 800 K=1, 75                                                              AVG4222
     DO 801 I=1,3                                                                AVG4223
     DO 802 J=1,6                                                                AVG4224
     SIGCT(I,K)=SIGCT(I,K)+SIGC(I,J,K)                                           AVG4225
     SIGST(I,K)=SIGST(I,K)+SIGS(I,J,K)                                           AVG4226
     SIGFT(I,K)=SIGFT(I,K)+SIGF(I,J,K)                                           AVG4227
 802 CONTINUE                                                                    AVG4228
     SIGST(I,K)=SIGST(I,K)+SIGPT(I,K)                                            AVG4229
 801 CONTINUE                                                                    AVG4230
 800 CONTINUE                                                                    AVG4231
     NN=NE(1,1)                                                                  AVG4232
     PRINT25                                                                     AVG4233
     PRINT37                                                                     AVG4234
     PRINT25                                                                     AVG4235
     PRINT34                                                                     AVG4236
     DO 900 K=1,NN                                                               AVG4237
     TERM=0.0                                                                    AVG4238
     DO 901 I=1,3                                                                AVG4239
     TERM=TERM+SIGST(I,K)                                                        AVG4240
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 901 CONTINUE                                                          AVG4241
     PRINT 24,E(1,1,K),SIGST(1,K),SIGST(2,K),SIGST(3,K),TERM           AVG4242
 900 CONTINUE                                                          AVG4243
     PRINT25                                                           AVG4244
     PRINT38                                                           AVG4245
     PRINT25                                                           AVG4246
     PRINT35                                                           AVG4247
     DO 902 K=1,NN                                                     AVG4248
     TERM=0.0                                                          AVG4249
     DO 903 I=1,3                                                      AVG4250
     TERM=TERM+SIGCT(I,K)                                              AVG4251
 903 CONTINUE                                                          AVG4252
     PRINT 24,E(1,1,K),SIGCT(1,K),SIGCT(2,K),SIGCT(3,K),TERM           AVG4253
 902 CONTINUE                                                          AVG4254
     PRINT25                                                           AVG4255
     PRINT39                                                           AVG4256
     PRINT25                                                           AVG4257
     PRINT36                                                           AVG4258
     DO 904 K=1,NN                                                     AVG4259
     TERM=0.0                                                          AVG4260
     DO 905 I=1,3                                                      AVG4261
     TERM=TERM+SIGFT(I,K)                                              AVG4262
 905 CONTINUE                                                          AVG4263
     PRINT 24,E(1,1,K),SIGFT(1,K),SIGFT(2,K),SIGFT(3,K),TERM           AVG4264
 904 CONTINUE                                                          AVG4265
     GO TO 881                                                         AVG4266
8800 CALL EXIT                                                         AVG4267
     END                                                               AVG4268
     SUBROUTINE GNRL(GALPHA,GBETA,GAMMA,MU,NU,LAMBDA,S,DF,ID)          GNRL001
     COMMON/XBAR/XX(4,10)                                              GNRL002
     S=0.0                                                             GNRL003
     IF(GALPHA)1000,1000,1001                                          GNRL004
1001 IF(GAMMA)1000,1000,1002                                           GNRL005
1002 IF(GBETA)1000,1003,1004                                           GNRL006
1003 IF(DF)1000,1005,1006                                              GNRL007
1005 DO 100 J=1,10                                                     GNRL008
     XJ=XX(MU,J)                                                       GNRL009
     GO TO(200,201,202),ID                                             GNRL010
 200 S=S+((XJ*XJ)/(GALPHA*XJ+GAMMA))                                   GNRL011
     GO TO 100                                                         GNRL012
 201 S=S+(XJ/(GALPHA*XJ+GAMMA))                                        GNRL013
 202 CONTINUE                                                          GNRL014
 100 CONTINUE                                                          GNRL015
     S=S/10.0                                                          GNRL016
     GO TO 1000                                                        GNRL017
1006 DO 101 J=1,10                                                     GNRL018
     XJ=XX(MU,J)                                                       GNRL019
     DO 102 K=1,10                                                     GNRL020
     XK=XX(LAMBDA,K)                                                   GNRL021
     GO TO(300,301,302),ID                                             GNRL022
 300 S=S+((XJ*XJ)/(GALPHA*XJ+GAMMA+DF*XK))                             GNRL023
     GO TO 102                                                         GNRL024
 301 S=S+(XJ/(GALPHA*XJ+GAMMA+DF*XK))                                  GNRL025
 302 CONTINUE                                                          GNRL026
 102 CONTINUE                                                          GNRL027
 101 CONTINUE                                                          GNRL028
     S=S/100.0                                                         GNRL029
     GO TO 1000                                                        GNRL030
1004 IF(DF)1000,1007,1008                                              GNRL031
1007 DO 103 J=1,10                                                     GNRL032
     XJ=XX(MU,J)                                                       GNRL033
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      DO 104 K=1,10                                                    GNRL034
      XK=XX(NU,K)                                                      GNRL035
      GO TO(400,401,402),ID                                            GNRL036
  400 S=S+((XJ*XJ)/(GALPHA*XJ+GBETA*XK+GAMMA))                         GNRL037
      GO TO 104                                                        GNRL038
  401 S=S+(XJ/(GALPHA*XJ+GBETA*XK+GAMMA))                              GNRL039
      GO TO 104                                                        GNRL040
  402 S=S+((XJ*XK)/(GALPHA*XJ+GBETA*XK+GAMMA))                         GNRL041
  104 CONTINUE                                                         GNRL042
  103 CONTINUE                                                         GNRL043
      S=S/100.0                                                        GNRL044
      GO TO 1000                                                       GNRL045
 1008 DO 105 J=1,10                                                    GNRL046
      XJ=XX(MU,J)                                                      GNRL047
      DO 106 K=1,10                                                    GNRL048
      XK=XX(NU,K)                                                      GNRL049
      DO 107 L=1,10                                                    GNRL050
      XL=XX(LAMBDA,L)                                                  GNRL051
      GO TO(500,501,502),ID                                            GNRL052
  500 S=S+((XJ*XJ)/(GALPHA*XJ+GBETA*XK+GAMMA+DF*XL))                   GNRL053
      GO TO 107                                                        GNRL054
  501 S=S+(XJ/(GALPHA*XJ+GBETA*XK+GAMMA+DF*XL))                        GNRL055
      GO TO 107                                                        GNRL056
  502 S=S+((XJ*XK)/(GALPHA*XJ+GBETA*XK+GAMMA+DF*XL))                   GNRL057
  107 CONTINUE                                                         GNRL058
  106 CONTINUE                                                         GNRL059
  105 CONTINUE                                                         GNRL060
      S=S/1000.0                                                       GNRL061
 1000 RETURN                                                           GNRL062
      END                                                              GNRL063
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     100 AVERAGE4 TEST, U-235 DATA
64,504      24788,0                 2           2           0           01102 2151
3.5         0.926                   0           0           2           01102 2151
233,025     0.0                     0           0           2           01102 2151
3.0000E+00  0.                      5           0         156         251102 2151
0.          0.          0.            1,0000E+00 0.          2,0000E+001102 2151
6.4504E+01  1.0000E+00  0.            7,1807E-05 3,5000E-02 2,9347E-01
8.2902E+01  1.0000E+00  0.            8,1753E-05 3,5000E-02 2,9133E-01
1.1569E+02  1.0000E+00  0.            9,0472E-05 3,5000E-02 2,4665E-01
1.4855E+02  1.0000E+00  0.            1,0486E-04 3,5000E-02 2,1766E-01
1.9074E+02  1.0000E+00  0.            1,0389E-04 3,5000E-02 2,6593E-01
2.4491E+02  1.0000E+00  0.            1,3175E-04 3,5000E-02 3,8029E-01
3.1447E+02  1.0000E+00  0.            9,6060E-05 3,5000E-02 3,5141E-01
4.0379E+02  1.0000E+00  0.            8,8629E-05 3,5000E-02 3,7344E-01
5.1848E+02  1.0000E+00  0.            1,1455E-04 3,5000E-02 5,1390E-01
6.6574E+02  1.0000E+00  0.            1,1126E-04 3,5000E-02 3,4713E-01
8.5482E+02  1.0000E+00  0.            1,0479E-04 3,5000E-02 2,5096E-01
1.0976E+03  1.0000E+00  0.            1,1267E-04 3,5000E-02 2,5373E-01
1.4093E+03  1.0000E+00  0.            9,9890E-05 3,5000E-02 3,4813E-01
1.8096E+03  1.0000E+00  0.            1,0160E-04 3,5000E-02 3,7083E-01
2.3236E+03  1.0000E+00  0.            9,8627E-05 3,5000E-02 4,3610E-01
2.9836E+03  1.0000E+00  0.            9,9029E-05 3,5000E-02 4,3348E-01
3.8310E+03  1.0000E+00  0.            1,0729E-04 3,5000E-02 4,2475E-01
4.9191E+03  1.0000E+00  0.            9,9664E-05 3,5000E-02 4,3055E-01
6.3163E+03  1.0000E+00  0.            9,6419E-05 3,5000E-02 4,3506E-01
8.1103E+03  1.0000E+00  0.            9,4417E-05 3,5000E-02 4,4334E-01
1.0414E+04  1.0000E+00  0.            9,7638E-05 3,5000E-02 4,4325E-01
1.3372E+04  1.0000E+00  0.            9,9719E-05 3,5000E-02 4,4530E-01
1.7169E+04  1.0000E+00  0.            9,8693E-05 3,5000E-02 4,5646E-01
2.2046E+04  1.0000E+00  0.            9,5268E-05 3,5000E-02 4,7366E-01
2.4788E+04  1.0000E+00  0.            1,0075E-04 3,5000E-02 4,6219E-01
4.0000E+00  0.                      5           0         156         251102 2151
0.          0.          0.            1,0000E+00 0.          1,0000E+001102 2151
6.4504E+01  1.0000E+00  0.            7,1807E-05 3,5000E-02 1,4673E-01
8.2902E+01  1.0000E+00  0.            8,1753E-05 3,5000E-02 1,4567E-01
1.1569E+02  1.0000E+00  0.            9,0472E-05 3,5000E-02 1,2333E-01
1.4855E+02  1.0000E+00  0.            1,0486E-04 3,5000E-02 1,0883E-01
1.9074E+02  1.0000E+00  0.            1,0389E-04 3,5000E-02 1,3297E-01
2.4491E+02  1.0000E+00  0.            1,3175E-04 3,5000E-02 1,9015E-01
3.1447E+02  1.0000E+00  0.            9,6060E-05 3,5000E-02 1,7571E-01
4.0379E+02  1.0000E+00  0.            8,8629E-05 3,5000E-02 1,8672E-01
5.1848E+02  1.0000E+00  0.            1,1455E-04 3,5000E-02 2,5695E-01
6.6574E+02  1.0000E+00  0.            1,1126E-04 3,5000E-02 1,7357E-01
8.5482E+02  1.0000E+00  0.            1,0479E-04 3,5000E-02 1,2548E-01
1.0976E+03  1.0000E+00  0.            1,1267E-04 3,5000E-02 1,2687E-01
1.4093E+03  1.0000E+00  0.            9,9890E-05 3,5000E-02 1,7406E-01
1.8096E+03  1.0000E+00  0.            1,0160E-04 3,5000E-02 1,8542E-01
2.3236E+03  1.0000E+00  0.            9,8627E-05 3,5000E-02 2,1805E-01
2.9836E+03  1.0000E+00  0.            9,9029E-05 3,5000E-02 2,1674E-01
3.8310E+03  1.0000E+00  0.            1,0729E-04 3,5000E-02 2,1238E-01
4.9191E+03  1.0000E+00  0.            9,9664E-05 3,5000E-02 2,1528E-01
6.3163E+03  1.0000E+00  0.            9,6419E-05 3,5000E-02 2,1753E-01
8.1103E+03  1.0000E+00  0.            9,4417E-05 3,5000E-02 2,2167E-01
1.0414E+04  1.0000E+00  0.            9,7638E-05 3,5000E-02 2,2163E-01
1.3372E+04  1.0000E+00  0.            9,9719E-05 3,5000E-02 2,2265E-01
1.7169E+04  1.0000E+00  0.            9,8693E-05 3,5000E-02 2,2823E-01
2.2046E+04  1.0000E+00  0.            9,5268E-05 3,5000E-02 2,3683E-01
2.4788E+04  1.0000E+00  0.            1,0075E-04 3,5000E-02 2,3110E-01
2.3302E+02  0.                      1           0           4           1102 2151
2.0000E+00  0.                      5           0         156         251102 2151
0.          0.          0.            1,0000E+00 0.          2,0000E+001102 2151
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6.4504E+01 1.1600E+00 0.          2.3200E-04 3.5000E-02 3.3200E-01
8.2902E+01 1.1600E+00 0.          2.3200E-04 3.5000E-02 3.3200E-01
1.1569E+02 1.1600E+00 0.          2.3200E-04 3.5000E-02 3.3200E-01
1.4855E+02 1.1600E+00 0.          2.3200E-04 3.5000E-02 3.3200E-01
1.9074E+02 1.1600E+00 0.          2.3200E-04 3.5000E-02 3.3200E-01
2.4491E+02 1.1600E+00 0.          2.3200E-04 3.5000E-02 3.3200E-01
3.1447E+02 1.1600E+00 0.          2.3200E-04 3.5000E-02 3.3200E-01
4.0379E+02 1.1600E+00 0.          2.3200E-04 3.5000E-02 3.3200E-01
5.1848E+02 1.1600E+00 0.          2.3200E-04 3.5000E-02 3.3200E-01
6.6574E+02 1.1600E+00 0.          2.3200E-04 3.5000E-02 3.3200E-01
8.5482E+02 1.1600E+00 0.          2.3200E-04 3.5000E-02 3.3200E-01
1.0976E+03 1.1600E+00 0.          2.3200E-04 3.5000E-02 3.3200E-01
1.4093E+03 1.1600E+00 0.          2.3200E-04 3.5000E-02 3.3200E-01
1.8096E+03 1.1600E+00 0.          2.3200E-04 3.5000E-02 3.3200E-01
2.3236E+03 1.1600E+00 0.          2.3200E-04 3.5000E-02 3.3200E-01
2.9836E+03 1.1600E+00 0.          2.3200E-04 3.5000E-02 3.3200E-01
3.8310E+03 1.1600E+00 0.          2.3200E-04 3.5000E-02 3.3200E-01
4.9191E+03 1.1600E+00 0.          2.3200E-04 3.5000E-02 3.3200E-01
6.3163E+03 1.1600E+00 0.          2.3200E-04 3.5000E-02 3.3200E-01
8.1103E+03 1.1600E+00 0.          2.3200E-04 3.5000E-02 3.3200E-01
1.0414E+04 1.1600E+00 0.          2.3200E-04 3.5000E-02 3.3200E-01
1.3372E+04 1.1600E+00 0.          2.3200E-04 3.5000E-02 3.3200E-01
1.7169E+04 1.1600E+00 0.          2.3200E-04 3.5000E-02 3.3200E-01
2.2046E+04 1.1600E+00 0.          2.3200E-04 3.5000E-02 3.3200E-01
2.4788E+04 1.1600E+00 0.          2.3200E-04 3.5000E-02 3.3200E-01
3.0000E+00 0.                  5           0         156          251102 2151
0.         0.          0.          2.0000E+00 0,          1.0000E+001102 2151
6.4504E+01 1.0000E+00 0.          2.0000E-04 3.5000E-02 1.2700E-01
8.2902E+01 1.0000E+00 0.          2.0000E-04 3.5000E-02 1.2700E-01
1.1569E+02 1.0000E+00 0.          2.0000E-04 3.5000E-02 1.2700E-01
1.4855E+02 1.0000E+00 0.          2.0000E-04 3.5000E-02 1.2700E-01
1.9074E+02 1.0000E+00 0.          2.0000E-04 3.5000E-02 1.2700E-01
2.4491E+02 1.0000E+00 0.          2.0000E-04 3.5000E-02 1.2700E-01
3.1447E+02 1.0000E+00 0.          2.0000E-04 3.5000E-02 1.2700E-01
4.0379E+02 1.0000E+00 0.          2.0000E-04 3.5000E-02 1.2700E-01
5.1848E+02 1.0000E+00 0.          2.0000E-04 3.5000E-02 1.2700E-01
6.6574E+02 1.0000E+00 0.          2.0000E-04 3.5000E-02 1.2700E-01
8.5482E+02 1.0000E+00 0.          2.0000E-04 3.5000E-02 1.2700E-01
1.0976E+03 1.0000E+00 0.          2.0000E-04 3.5000E-02 1.2700E-01
1.4093E+03 1.0000E+00 0.          2.0000E-04 3.5000E-02 1.2700E-01
1.8096E+03 1.0000E+00 0.          2.0000E-04 3.5000E-02 1.2700E-01
2.3236E+03 1.0000E+00 0.          2.0000E-04 3.5000E-02 1.2700E-01
2.9836E+03 1.0000E+00 0.          2.0000E-04 3.5000E-02 1.2700E-01
3.8310E+03 1.0000E+00 0.          2.0000E-04 3.5000E-02 1.2700E-01
4.9191E+03 1.0000E+00 0.          2.0000E-04 3.5000E-02 1.2700E-01
6.3163E+03 1.0000E+00 0.          2.0000E-04 3.5000E-02 1.2700E-01
8.1103E+03 1.0000E+00 0.          2.0000E-04 3.5000E-02 1.2700E-01
1.0414E+04 1.0000E+00 0.          2.0000E-04 3.5000E-02 1.2700E-01
1.3372E+04 1.0000E+00 0.          2.0000E-04 3.5000E-02 1.2700E-01
1.7169E+04 1.0000E+00 0.          2.0000E-04 3.5000E-02 1.2700E-01
2.2046E+04 1.0000E+00 0.          2.0000E-04 3.5000E-02 1.2700E-01
2.4788E+04 1.0000E+00 0.          2.0000E-04 3.5000E-02 1.2700E-01
4.0000E+00 0.                  5           0         156          251102 2151
0.         0.          0.          2.0000E+00 0,          2.0000E+001102 2151
6.4504E+01 1.0000E+00 0.          2.0000E-04 3.5000E-02 2.8600E-01
8.2902E+01 1.0000E+00 0.          2.0000E-04 3.5000E-02 2.8600E-01
1.1569E+02 1.0000E+00 0.          2.0000E-04 3.5000E-02 2.8600E-01
1.4855E+02 1.0000E+00 0.          2.0000E-04 3.5000E-02 2.8600E-01
1.9074E+02 1.0000E+00 0.          2.0000E-04 3.5000E-02 2.8600E-01
2.4491E+02 1.0000E+00 0.          2.0000E-04 3.5000E-02 2.8600E-01
3.1447E+02 1.0000E+00 0.          2.0000E-04 3.5000E-02 2.8600E-01
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4.0379E+02 1.0000E+00 0.          2.0000E-04 3.5000E-02 2.8600E-01
5.1848E+02 1.0000E+00 0.          2.0000E-04 3.5000E-02 2.8600E-01
6.6574E+02 1.0000E+00 0.          2.0000E-04 3.5000E-02 2.8600E-01
8.5482E+02 1.0000E+00 0.          2.0000E-04 3.5000E-02 2.8600E-01
1.0976E+03 1.0000E+00 0.          2.0000E-04 3.5000E-02 2.8600E-01
1.4093E+03 1.0000E+00 0.          2.0000E-04 3.5000E-02 2.8600E-01
1.8096E+03 1.0000E+00 0.          2.0000E-04 3.5000E-02 2.8600E-01
2.3236E+03 1.0000E+00 0.          2.0000E-04 3.5000E-02 2.8600E-01
2.9836E+03 1.0000E+00 0.          2.0000E-04 3.5000E-02 2.8600E-01
3.8310E+03 1.0000E+00 0.          2.0000E-04 3.5000E-02 2.8600E-01
4.9191E+03 1.0000E+00 0.          2.0000E-04 3.5000E-02 2.8600E-01
6.3163E+03 1.0000E+00 0.          2.0000E-04 3.5000E-02 2.8600E-01
8.1103E+03 1.0000E+00 0.          2.0000E-04 3.5000E-02 2.8600E-01
1.0414E+04 1.0000E+00 0.          2.0000E-04 3.5000E-02 2.8600E-01
1.3372E+04 1.0000E+00 0.          2.0000E-04 3.5000E-02 2.8600E-01
1.7169E+04 1.0000E+00 0.          2.0000E-04 3.5000E-02 2.8600E-01
2.2046E+04 1.0000E+00 0.          2.0000E-04 3.5000E-02 2.8600E-01
2.4788E+04 1.0000E+00 0.          2.0000E-04 3.5000E-02 2.8600E-01
5.0000E+00 0.                  5          0         156          251102 2151
0.         0.          0.        1.0000E+00 0.          1.0000E+00 1102 2151
6.4504E+01 1.1200E+00 0.          2.2400E-04 3.5000E-02 1.4300E-01
8.2902E+01 1.1200E+00 0.          2.2400E-04 3.5000E-02 1.4300E-01
1.1569E+02 1.1200E+00 0.          2.2400E-04 3.5000E-02 1.4300E-01
1.4855E+02 1.1200E+00 0.          2.2400E-04 3.5000E-02 1.4300E-01
1.9074E+02 1.1200E+00 0.          2.2400E-04 3.5000E-02 1.4300E-01
2.4491E+02 1.1200E+00 0.          2.2400E-04 3.5000E-02 1.4300E-01
3.1447E+02 1.1200E+00 0.          2.2400E-04 3.5000E-02 1.4300E-01
4.0379E+02 1.1200E+00 0.          2.2400E-04 3.5000E-02 1.4300E-01
5.1848E+02 1.1200E+00 0.          2.2400E-04 3.5000E-02 1.4300E-01
6.6574E+02 1.1200E+00 0.          2.2400E-04 3.5000E-02 1.4300E-01
8.5482E+02 1.1200E+00 0.          2.2400E-04 3.5000E-02 1.4300E-01
1.0976E+03 1.1200E+00 0.          2.2400E-04 3.5000E-02 1.4300E-01
1.4093E+03 1.1200E+00 0.          2.2400E-04 3.5000E-02 1.4300E-01
1.8096E+03 1.1200E+00 0.          2.2400E-04 3.5000E-02 1.4300E-01
2.3236E+03 1.1200E+00 0.          2.2400E-04 3.5000E-02 1.4300E-01
2.9836E+03 1.1200E+00 0.          2.2400E-04 3.5000E-02 1.4300E-01
3.8310E+03 1.1200E+00 0.          2.2400E-04 3.5000E-02 1.4300E-01
4.9191E+03 1.1200E+00 0.          2.2400E-04 3.5000E-02 1.4300E-01
6.3163E+03 1.1200E+00 0.          2.2400E-04 3.5000E-02 1.4300E-01
8.1103E+03 1.1200E+00 0.          2.2400E-04 3.5000E-02 1.4300E-01
1.0414E+04 1.1200E+00 0.          2.2400E-04 3.5000E-02 1.4300E-01
1.3372E+04 1.1200E+00 0.          2.2400E-04 3.5000E-02 1.4300E-01
1.7169E+04 1.1200E+00 0.          2.2400E-04 3.5000E-02 1.4300E-01
2.2046E+04 1.1200E+00 0.          2.2400E-04 3.5000E-02 1.4300E-01
2.4788E+04 1.1200E+00 0.          2.2400E-04 3.5000E-02 1.4300E-01
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PROGRAM AVRAGE4, CALCULATES CROSS-SECTIONS IN THE UNRESOLVED RESONANCE REGION

ENDF/B VERSION II DATA WITH ENERGY DEPENDENT PARAMETERS

RUN NO 100 TITLE AVERAGE4 TEST, U-235 DATA

ENERGY LIMITS LOWER 6.450400E+01 UPPER 2.478800E+04 LRU= 2 LRF= 2

TARGET SPIN 3.5000E+00 SCATTERING LENGTH 9.2600E-01 NUMBER OF L-STATES 2

NUCLEAR RADIUS'A' AS CALCULATED FROM A=(1.23*(MASS**(1/3)+0.8)*0.1 = 8.3908E-01

NUCLEAR MASS/NEUTRON MASS 2.3302E+02 ANGULAR MOMENTUM 0 NUMBER OF J-STATES FOR THIS L-VALUE 2

SPIN 3.0000E+00 INTERPOLATION CODE 5 NUMBER OF ENERGY POINTS 25
DEGREES OF FREEDOM, NU INELASTIC 0.0000E+00 NU NEUTRON 1.0000E+00 NU GAMMA 0.0000E+00 NU FISSION 2.0000E+00

ENERGY(EV)	SPACING	GAMMA INELAS	GAMMA N NOT	GAMMA GAMMA	GAMMAFISS
6.450400E+01	1.000000E+00	0.000000E+00	7.180700E-05	3.500000E-02	2.934700E-01
8.290200E+01	1.000000E+00	0.000000E+00	8.175300E-05	3.500000E-02	2.913300E-01
1.156900E+02	1.000000E+00	0.000000E+00	9.047200E-05	3.500000E-02	2.466500E-01
1.485500E+02	1.000000E+00	0.000000E+00	1.048600E-04	3.500000E-02	2.176600E-01
1.907400E+02	1.000000E+00	0.000000E+00	1.038900E-04	3.500000E-02	2.659300E-01
2.449100E+02	1.000000E+00	0.000000E+00	1.317500E-04	3.500000E-02	3.802900E-01
3.144700E+02	1.000000E+00	0.000000E+00	9.606000E-05	3.500000E-02	3.514100E-01
4.037900E+02	1.000000E+00	0.000000E+00	8.862900E-05	3.500000E-02	3.734400E-01
5.184800E+02	1.000000E+00	0.000000E+00	1.145500E-04	3.500000E-02	5.139000E-01
6.657400E+02	1.000000E+00	0.000000E+00	1.112600E-04	3.500000E-02	3.471300E-01
8.548200E+02	1.000000E+00	0.000000E+00	1.047900E-04	3.500000E-02	2.509600E-01
1.097600E+03	1.000000E+00	0.000000E+00	1.126700E-04	3.500000E-02	2.537300E-01
1.409300E+03	1.000000E+00	0.000000E+00	9.989000E-05	3.500000E-02	3.481300E-01
1.809600E+03	1.000000E+00	0.000000E+00	1.016000E-04	3.500000E-02	3.708300E-01
2.323600E+03	1.000000E+00	0.000000E+00	9.862700E-05	3.500000E-02	4.361000E-01
2.983600E+03	1.000000E+00	0.000000E+00	9.902900E-05	3.500000E-02	4.334800E-01
3.831000E+03	1.000000E+00	0.000000E+00	1.072900E-04	3.500000E-02	4.247500E-01
4.919100E+03	1.000000E+00	0.000000E+00	9.966400E-05	3.500000E-02	4.305500E-01
6.316300E+03	1.000000E+00	0.000000E+00	9.641900E-05	3.500000E-02	4.350600E-01
8.110300E+03	1.000000E+00	0.000000E+00	9.441700E-05	3.500000E-02	4.433400E-01
1.041400E+04	1.000000E+00	0.000000E+00	9.763800E-05	3.500000E-02	4.432500E-01
1.337200E+04	1.000000E+00	0.000000E+00	9.971900E-05	3.500000E-02	4.453000E-01
1.716900E+04	1.000000E+00	0.000000E+00	9.869300E-05	3.500000E-02	4.564600E-01

2.204600E+04	1.000000E+00	0.000000E+00	9.526800E-05	3.500000E-02	4.736600E-01
2.478800E+04	1.000000E+00	0.000000E+00	1.007500E-04	3.500000E-02	4.621900E-01

SPIN 4.0000E+00 INTERPOLATION CODE 5 NUMBER OF ENERGY POINTS 25
DEGREES OF FREEDOM, NU INELASTIC 0.0000E+00 NU NEUTRON 1.0000E+00 NU GAMMA 0.0000E+00 NU FISSION 1.0000E+00

ENERGY(EV)	SPACING	GAMMA INELAS	GAMMA N NOT	GAMMA GAMMA	GAMMAFISS
6.450400E+01	1.000000E+00	0.000000E+00	7.180700E-05	3.500000E-02	1.467300E-01
8.290200E+01	1.000000E+00	0.000000E+00	8.175300E-05	3.500000E-02	1.456700E-01
1.156900E+02	1.000000E+00	0.000000E+00	9.047200E-05	3.500000E-02	1.233300E-01
1.485500E+02	1.000000E+00	0.000000E+00	1.048600E-04	3.500000E-02	1.088300E-01
1.907400E+02	1.000000E+00	0.000000E+00	1.038900E-04	3.500000E-02	1.329700E-01
2.449100E+02	1.000000E+00	0.000000E+00	1.317500E-04	3.500000E-02	1.901500E-01
3.144700E+02	1.000000E+00	0.000000E+00	9.606000E-05	3.500000E-02	1.757100E-01
4.037900E+02	1.000000E+00	0.000000E+00	8.862900E-05	3.500000E-02	1.867200E-01
5.184800E+02	1.000000E+00	0.000000E+00	1.145500E-04	3.500000E-02	2.569500E-01
6.657400E+02	1.000000E+00	0.000000E+00	1.112600E-04	3.500000E-02	1.735700E-01
8.548200E+02	1.000000E+00	0.000000E+00	1.047900E-04	3.500000E-02	1.254800E-01
1.097600E+03	1.000000E+00	0.000000E+00	1.126700E-04	3.500000E-02	1.268700E-01
1.409300E+03	1.000000E+00	0.000000E+00	9.989000E-05	3.500000E-02	1.740600E-01
1.809600E+03	1.000000E+00	0.000000E+00	1.016000E-04	3.500000E-02	1.854200E-01
2.323600E+03	1.000000E+00	0.000000E+00	9.862700E-05	3.500000E-02	2.180500E-01
2.983600E+03	1.000000E+00	0.000000E+00	9.902900E-05	3.500000E-02	2.167400E-01
3.831000E+03	1.000000E+00	0.000000E+00	1.072900E-04	3.500000E-02	2.123800E-01
4.919100E+03	1.000000E+00	0.000000E+00	9.966400E-05	3.500000E-02	2.152800E-01
6.316300E+03	1.000000E+00	0.000000E+00	9.641900E-05	3.500000E-02	2.175300E-01
8.110300E+03	1.000000E+00	0.000000E+00	9.441700E-05	3.500000E-02	2.216700E-01
1.041400E+04	1.000000E+00	0.000000E+00	9.763800E-05	3.500000E-02	2.216300E-01
1.337200E+04	1.000000E+00	0.000000E+00	9.971900E-05	3.500000E-02	2.226500E-01
1.716900E+04	1.000000E+00	0.000000E+00	9.869300E-05	3.500000E-02	2.282300E-01
2.204600E+04	1.000000E+00	0.000000E+00	9.526800E-05	3.500000E-02	2.368300E-01
2.478800E+04	1.000000E+00	0.000000E+00	1.007500E-04	3.500000E-02	2.311000E-01

NUCLEAR RADIUS'A' AS CALCULATED FROM A=(1.23*(MASS**(1/3)+0.8)*0.1 = 8.3908E-01

NUCLEAR MASS/NEUTRON MASS 2.3302E+02 ANGULAR MOMENTUM 1 NUMBER OF J-STATES FOR THIS L-VALUE 4

SPIN 2.0000E+00 INTERPOLATION CODE 5 NUMBER OF ENERGY POINTS 25
DEGREES OF FREEDOM, NU INELASTIC 0.0000E+00 NU NEUTRON 1.0000E+00 NU GAMMA 0.0000E+00 NU FISSION 2.0000E+00

ENERGY(EV)	SPACING	GAMMA INELAS	GAMMA N NOT	GAMMA GAMMA	GAMMAFISS
6.450400E+01	1.160000E+00	0.000000E+00	2.320000E-04	3.500000E-02	3.320000E-01
8.290200E+01	1.160000E+00	0.000000E+00	2.320000E-04	3.500000E-02	3.320000E-01
1.156900E+02	1.160000E+00	0.000000E+00	2.320000E-04	3.500000E-02	3.320000E-01
1.485500E+02	1.160000E+00	0.000000E+00	2.320000E-04	3.500000E-02	3.320000E-01
1.907400E+02	1.160000E+00	0.000000E+00	2.320000E-04	3.500000E-02	3.320000E-01
2.449100E+02	1.160000E+00	0.000000E+00	2.320000E-04	3.500000E-02	3.320000E-01
3.144700E+02	1.160000E+00	0.000000E+00	2.320000E-04	3.500000E-02	3.320000E-01
4.037900E+02	1.160000E+00	0.000000E+00	2.320000E-04	3.500000E-02	3.320000E-01
5.184800E+02	1.160000E+00	0.000000E+00	2.320000E-04	3.500000E-02	3.320000E-01
6.657400E+02	1.160000E+00	0.000000E+00	2.320000E-04	3.500000E-02	3.320000E-01

8.548200E+02	1.160000E+00	0.000000E+00	2.320000E-04	3.500000E-02	3.320000E-01
1.097600E+03	1.160000E+00	0.000000E+00	2.320000E-04	3.500000E-02	3.320000E-01
1.409300E+03	1.160000E+00	0.000000E+00	2.320000E-04	3.500000E-02	3.320000E-01
1.809600E+03	1.160000E+00	0.000000E+00	2.320000E-04	3.500000E-02	3.320000E-01
2.323600E+03	1.160000E+00	0.000000E+00	2.320000E-04	3.500000E-02	3.320000E-01
2.983600E+03	1.160000E+00	0.000000E+00	2.320000E-04	3.500000E-02	3.320000E-01
3.831000E+03	1.160000E+00	0.000000E+00	2.320000E-04	3.500000E-02	3.320000E-01
4.919100E+03	1.160000E+00	0.000000E+00	2.320000E-04	3.500000E-02	3.320000E-01
6.316300E+03	1.160000E+00	0.000000E+00	2.320000E-04	3.500000E-02	3.320000E-01
8.110300E+03	1.160000E+00	0.000000E+00	2.320000E-04	3.500000E-02	3.320000E-01
1.041400E+04	1.160000E+00	0.000000E+00	2.320000E-04	3.500000E-02	3.320000E-01
1.337200E+04	1.160000E+00	0.000000E+00	2.320000E-04	3.500000E-02	3.320000E-01
1.716900E+04	1.160000E+00	0.000000E+00	2.320000E-04	3.500000E-02	3.320000E-01
2.204600E+04	1.160000E+00	0.000000E+00	2.320000E-04	3.500000E-02	3.320000E-01
2.478800E+04	1.160000E+00	0.000000E+00	2.320000E-04	3.500000E-02	3.320000E-01

SPIN 3.0000E+00 INTERPOLATION CODE 5 NUMBER OF ENERGY POINTS 25
DEGREES OF FREEDOM, NU INELASTIC 0.0000E+00 NU NEUTRON 2.0000E+00 NU GAMMA 0.0000E+00 NU FISSION 1.0000E+00

ENERGY(EV)	SPACING	GAMMA INELAS	GAMMA N NOT	GAMMA GAMMA	GAMMAFISS
6.450400E+01	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	1.270000E-01
8.290200E+01	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	1.270000E-01
1.156900E+02	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	1.270000E-01
1.485500E+02	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	1.270000E-01
1.907400E+02	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	1.270000E-01
2.449100E+02	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	1.270000E-01
3.144700E+02	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	1.270000E-01
4.037900E+02	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	1.270000E-01
5.184800E+02	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	1.270000E-01
6.657400E+02	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	1.270000E-01
8.548200E+02	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	1.270000E-01
1.097600E+03	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	1.270000E-01
1.409300E+03	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	1.270000E-01
1.809600E+03	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	1.270000E-01
2.323600E+03	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	1.270000E-01
2.983600E+03	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	1.270000E-01
3.831000E+03	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	1.270000E-01
4.919100E+03	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	1.270000E-01
6.316300E+03	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	1.270000E-01
8.110300E+03	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	1.270000E-01
1.041400E+04	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	1.270000E-01
1.337200E+04	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	1.270000E-01
1.716900E+04	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	1.270000E-01
2.204600E+04	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	1.270000E-01
2.478800E+04	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	1.270000E-01

SPIN 4.0000E+00 INTERPOLATION CODE 5 NUMBER OF ENERGY POINTS 25
DEGREES OF FREEDOM, NU INELASTIC 0.0000E+00 NU NEUTRON 2.0000E+00 NU GAMMA 0.0000E+00 NU FISSION 2.0000E+00

ENERGY(EV)	SPACING	GAMMA INELAS	GAMMA N NOT	GAMMA GAMMA	GAMMAFISS
6.450400E+01	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	2.860000E-01
8.290200E+01	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	2.860000E-01
1.156900E+02	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	2.860000E-01
1.485500E+02	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	2.860000E-01
1.907400E+02	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	2.860000E-01
2.449100E+02	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	2.860000E-01
3.144700E+02	1.000000E+00	0.000000E+00	2.000000E-04	3.500000E-02	2.860000E-01

4,037900E+02	1,000000E+00	0,000000E+00	2,000000E-04	3,500000E-02	2,860000E-
5,184800E+02	1,000000E+00	0,000000E+00	2,000000E-04	3,500000E-02	2,860000E-
6,657400E+02	1,000000E+00	0,000000E+00	2,000000E-04	3,500000E-02	2,860000E-
8,548200E+02	1,000000E+00	0,000000E+00	2,000000E-04	3,500000E-02	2,860000E-
1,097600E+03	1,000000E+00	0,000000E+00	2,000000E-04	3,500000E-02	2,860000E-
1,409300E+03	1,000000E+00	0,000000E+00	2,000000E-04	3,500000E-02	2,860000E-
1,809600E+03	1,000000E+00	0,000000E+00	2,000000E-04	3,500000E-02	2,860000E-
2,323600E+03	1,000000E+00	0,000000E+00	2,000000E-04	3,500000E-02	2,860000E-
2,983600E+03	1,000000E+00	0,000000E+00	2,000000E-04	3,500000E-02	2,860000E-
3,831000E+03	1,000000E+00	0,000000E+00	2,000000E-04	3,500000E-02	2,860000E-
4,919100E+03	1,000000E+00	0,000000E+00	2,000000E-04	3,500000E-02	2,860000E-
6,316300E+03	1,000000E+00	0,000000E+00	2,000000E-04	3,500000E-02	2,860000E-
8,110300E+03	1,000000E+00	0,000000E+00	2,000000E-04	3,500000E-02	2,860000E-
1,041400E+04	1,000000E+00	0,000000E+00	2,000000E-04	3,500000E-02	2,860000E-
1,337200E+04	1,000000E+00	0,000000E+00	2,000000E-04	3,500000E-02	2,860000E-
1,716900E+04	1,000000E+00	0,000000E+00	2,000000E-04	3,500000E-02	2,860000E-
2,204600E+04	1,000000E+00	0,000000E+00	2,000000E-04	3,500000E-02	2,860000E-
2,478800E+04	1,000000E+00	0,000000E+00	2,000000E-04	3,500000E-02	2,860000E-

SPIN 5,0000E+00 INTERPOLATION CODE 5 NUMBER OF ENERGY POINTS 25
DEGREES OF FREEDOM, NU INELASTIC 0,0000E+00 NU NEUTRON 1,0000E+00 NU GAMMA 0,0000E+00 NU FISSION 1,0

ENERGY(EV)	SPACING	GAMMA INELAS	GAMMA N NOT	GAMMA GAMMA	GAMMAFISS
6,450400E+01	1,120000E+00	0,000000E+00	2,240000E-04	3,500000E-02	1,430000E-
8,290200E+01	1,120000E+00	0,000000E+00	2,240000E-04	3,500000E-02	1,430000E-
1,156900E+02	1,120000E+00	0,000000E+00	2,240000E-04	3,500000E-02	1,430000E-
1,485500E+02	1,120000E+00	0,000000E+00	2,240000E-04	3,500000E-02	1,430000E-
1,907400E+02	1,120000E+00	0,000000E+00	2,240000E-04	3,500000E-02	1,430000E-
2,449100E+02	1,120000E+00	0,000000E+00	2,240000E-04	3,500000E-02	1,430000E-
3,144700E+02	1,120000E+00	0,000000E+00	2,240000E-04	3,500000E-02	1,430000E-
4,037900E+02	1,120000E+00	0,000000E+00	2,240000E-04	3,500000E-02	1,430000E-
5,184800E+02	1,120000E+00	0,000000E+00	2,240000E-04	3,500000E-02	1,430000E-
6,657400E+02	1,120000E+00	0,000000E+00	2,240000E-04	3,500000E-02	1,430000E-
8,548200E+02	1,120000E+00	0,000000E+00	2,240000E-04	3,500000E-02	1,430000E-
1,097600E+03	1,120000E+00	0,000000E+00	2,240000E-04	3,500000E-02	1,430000E-
1,409300E+03	1,120000E+00	0,000000E+00	2,240000E-04	3,500000E-02	1,430000E-
1,809600E+03	1,120000E+00	0,000000E+00	2,240000E-04	3,500000E-02	1,430000E-
2,323600E+03	1,120000E+00	0,000000E+00	2,240000E-04	3,500000E-02	1,430000E-
2,983600E+03	1,120000E+00	0,000000E+00	2,240000E-04	3,500000E-02	1,430000E-
3,831000E+03	1,120000E+00	0,000000E+00	2,240000E-04	3,500000E-02	1,430000E-
4,919100E+03	1,120000E+00	0,000000E+00	2,240000E-04	3,500000E-02	1,430000E-
6,316300E+03	1,120000E+00	0,000000E+00	2,240000E-04	3,500000E-02	1,430000E-
8,110300E+03	1,120000E+00	0,000000E+00	2,240000E-04	3,500000E-02	1,430000E-
1,041400E+04	1,120000E+00	0,000000E+00	2,240000E-04	3,500000E-02	1,430000E-
1,337200E+04	1,120000E+00	0,000000E+00	2,240000E-04	3,500000E-02	1,430000E-
1,716900E+04	1,120000E+00	0,000000E+00	2,240000E-04	3,500000E-02	1,430000E-
2,204600E+04	1,120000E+00	0,000000E+00	2,240000E-04	3,500000E-02	1,430000E-
2,478800E+04	1,120000E+00	0,000000E+00	2,240000E-04	3,500000E-02	1,430000E-

INPUT PARAMETERS WITH CALCULATED TOTAL WIDTH

L-VALUE= 0 J-STATE= 3,00

ENERGY(EV)	SPACING	GAMMA INELAS	GAMMA TOTAL	GAMMA N NOT	GAMMA GAMMA	GAMMA FISS
6.450400E+01	1.000000E+00	0.000000E+00	3.290467E-01	7.180700E-05	3.500000E-02	2.934700E-01
8.290200E+01	1.000000E+00	0.000000E+00	3.270744E-01	8.175300E-05	3.500000E-02	2.913300E-01
1.156900E+02	1.000000E+00	0.000000E+00	2.826231E-01	9.047200E-05	3.500000E-02	2.466500E-01
1.485500E+02	1.000000E+00	0.000000E+00	2.539380E-01	1.048600E-04	3.500000E-02	2.176600E-01
1.907400E+02	1.000000E+00	0.000000E+00	3.023648E-01	1.038900E-04	3.500000E-02	2.659300E-01
2.449100E+02	1.000000E+00	0.000000E+00	4.173518E-01	1.317500E-04	3.500000E-02	3.802900E-01
3.144700E+02	1.000000E+00	0.000000E+00	3.881135E-01	9.606000E-05	3.500000E-02	3.514100E-01
4.037900E+02	1.000000E+00	0.000000E+00	4.102210E-01	8.862900E-05	3.500000E-02	3.734400E-01
5.184800E+02	1.000000E+00	0.000000E+00	5.515083E-01	1.145500E-04	3.500000E-02	5.139000E-01
6.657400E+02	1.000000E+00	0.000000E+00	3.850007E-01	1.112600E-04	3.500000E-02	3.471300E-01
8.548200E+02	1.000000E+00	0.000000E+00	2.890238E-01	1.047900E-04	3.500000E-02	2.509600E-01
1.097600E+03	1.000000E+00	0.000000E+00	2.924628E-01	1.126700E-04	3.500000E-02	2.537300E-01
1.409300E+03	1.000000E+00	0.000000E+00	3.868799E-01	9.989000E-05	3.500000E-02	3.481300E-01
1.809600E+03	1.000000E+00	0.000000E+00	4.101520E-01	1.016000E-04	3.500000E-02	3.708300E-01
2.323600E+03	1.000000E+00	0.000000E+00	4.758542E-01	9.862700E-05	3.500000E-02	4.361000E-01
2.983600E+03	1.000000E+00	0.000000E+00	4.738892E-01	9.902900E-05	3.500000E-02	4.334800E-01
3.831000E+03	1.000000E+00	0.000000E+00	4.663907E-01	1.072900E-04	3.500000E-02	4.247500E-01
4.919100E+03	1.000000E+00	0.000000E+00	4.725401E-01	9.966400E-05	3.500000E-02	4.305500E-01
6.316300E+03	1.000000E+00	0.000000E+00	4.777229E-01	9.641900E-05	3.500000E-02	4.350600E-01
8.110300E+03	1.000000E+00	0.000000E+00	4.868429E-01	9.441700E-05	3.500000E-02	4.433400E-01
1.041400E+04	1.000000E+00	0.000000E+00	4.882139E-01	9.763800E-05	3.500000E-02	4.432500E-01
1.337200E+04	1.000000E+00	0.000000E+00	4.918312E-01	9.971900E-05	3.500000E-02	4.453000E-01
1.716900E+04	1.000000E+00	0.000000E+00	5.043918E-01	9.869300E-05	3.500000E-02	4.564600E-01
2.204600E+04	1.000000E+00	0.000000E+00	5.228053E-01	9.526800E-05	3.500000E-02	4.736600E-01
2.478800E+04	1.000000E+00	0.000000E+00	5.130523E-01	1.007500E-04	3.500000E-02	4.621900E-01

L-VALUE= 0 J-STATE= 4.00

ENERGY(EV)	SPACING	GAMMA INELAS	GAMMA TOTAL	GAMMA N NOT	GAMMA GAMMA	GAMMA FISS
6.450400E+01	1.000000E+00	0.000000E+00	1.823067E-01	7.180700E-05	3.500000E-02	1.467300E-01
8.290200E+01	1.000000E+00	0.000000E+00	1.814144E-01	8.175300E-05	3.500000E-02	1.456700E-01
1.156900E+02	1.000000E+00	0.000000E+00	1.593031E-01	9.047200E-05	3.500000E-02	1.233300E-01
1.485500E+02	1.000000E+00	0.000000E+00	1.451080E-01	1.048600E-04	3.500000E-02	1.088300E-01
1.907400E+02	1.000000E+00	0.000000E+00	1.694048E-01	1.038900E-04	3.500000E-02	1.329700E-01
2.449100E+02	1.000000E+00	0.000000E+00	2.272118E-01	1.317500E-04	3.500000E-02	1.901500E-01
3.144700E+02	1.000000E+00	0.000000E+00	2.124135E-01	9.606000E-05	3.500000E-02	1.757100E-01
4.037900E+02	1.000000E+00	0.000000E+00	2.235010E-01	8.862900E-05	3.500000E-02	1.867200E-01
5.184800E+02	1.000000E+00	0.000000E+00	2.945583E-01	1.145500E-04	3.500000E-02	2.569500E-01
6.657400E+02	1.000000E+00	0.000000E+00	2.114407E-01	1.112600E-04	3.500000E-02	1.735700E-01
8.548200E+02	1.000000E+00	0.000000E+00	1.635438E-01	1.047900E-04	3.500000E-02	1.254800E-01
1.097600E+03	1.000000E+00	0.000000E+00	1.656028E-01	1.126700E-04	3.500000E-02	1.268700E-01
1.409300E+03	1.000000E+00	0.000000E+00	2.128099E-01	9.989000E-05	3.500000E-02	1.740600E-01
1.809600E+03	1.000000E+00	0.000000E+00	2.247420E-01	1.016000E-04	3.500000E-02	1.854200E-01
2.323600E+03	1.000000E+00	0.000000E+00	2.578042E-01	9.862700E-05	3.500000E-02	2.180500E-01
2.983600E+03	1.000000E+00	0.000000E+00	2.571492E-01	9.902900E-05	3.500000E-02	2.167400E-01
3.831000E+03	1.000000E+00	0.000000E+00	2.540207E-01	1.072900E-04	3.500000E-02	2.123800E-01
4.919100E+03	1.000000E+00	0.000000E+00	2.572701E-01	9.966400E-05	3.500000E-02	2.152800E-01
6.316300E+03	1.000000E+00	0.000000E+00	2.601929E-01	9.641900E-05	3.500000E-02	2.175300E-01
8.110300E+03	1.000000E+00	0.000000E+00	2.651729E-01	9.441700E-05	3.500000E-02	2.216700E-01
1.041400E+04	1.000000E+00	0.000000E+00	2.665939E-01	9.763800E-05	3.500000E-02	2.216300E-01
1.337200E+04	1.000000E+00	0.000000E+00	2.691812E-01	9.971900E-05	3.500000E-02	2.226500E-01
1.716900E+04	1.000000E+00	0.000000E+00	2.761618E-01	9.869300E-05	3.500000E-02	2.282300E-01
2.204600E+04	1.000000E+00	0.000000E+00	2.859753E-01	9.526800E-05	3.500000E-02	2.368300E-01
2.478800E+04	1.000000E+00	0.000000E+00	2.819623E-01	1.007500E-04	3.500000E-02	2.311000E-01

L-VALUE= 1 J-STATE= 2.00

ENERGY(EV)	SPACING	GAMMA INELAS	GAMMA TOTAL	GAMMA N NOT	GAMMA GAMMA	GAMMA FISS
6.450400E+01	1.160000E+00	0.000000E+00	3.670004E-01	2.320000E-04	3.500000E-02	3.320000E-01
8.290200E+01	1.160000E+00	0.000000E+00	3.670006E-01	2.320000E-04	3.500000E-02	3.320000E-01
1.156900E+02	1.160000E+00	0.000000E+00	3.670010E-01	2.320000E-04	3.500000E-02	3.320000E-01
1.485500E+02	1.160000E+00	0.000000E+00	3.670014E-01	2.320000E-04	3.500000E-02	3.320000E-01
1.907400E+02	1.160000E+00	0.000000E+00	3.670021E-01	2.320000E-04	3.500000E-02	3.320000E-01
2.449100E+02	1.160000E+00	0.000000E+00	3.670030E-01	2.320000E-04	3.500000E-02	3.320000E-01
3.144700E+02	1.160000E+00	0.000000E+00	3.670044E-01	2.320000E-04	3.500000E-02	3.320000E-01
4.037900E+02	1.160000E+00	0.000000E+00	3.670063E-01	2.320000E-04	3.500000E-02	3.320000E-01
5.184800E+02	1.160000E+00	0.000000E+00	3.670092E-01	2.320000E-04	3.500000E-02	3.320000E-01
6.657400E+02	1.160000E+00	0.000000E+00	3.670134E-01	2.320000E-04	3.500000E-02	3.320000E-01
8.548200E+02	1.160000E+00	0.000000E+00	3.670195E-01	2.320000E-04	3.500000E-02	3.320000E-01
1.097600E+03	1.160000E+00	0.000000E+00	3.670283E-01	2.320000E-04	3.500000E-02	3.320000E-01
1.409300E+03	1.160000E+00	0.000000E+00	3.670412E-01	2.320000E-04	3.500000E-02	3.320000E-01
1.809600E+03	1.160000E+00	0.000000E+00	3.670598E-01	2.320000E-04	3.500000E-02	3.320000E-01
2.323600E+03	1.160000E+00	0.000000E+00	3.670869E-01	2.320000E-04	3.500000E-02	3.320000E-01
2.983600E+03	1.160000E+00	0.000000E+00	3.671261E-01	2.320000E-04	3.500000E-02	3.320000E-01
3.831000E+03	1.160000E+00	0.000000E+00	3.671830E-01	2.320000E-04	3.500000E-02	3.320000E-01
4.919100E+03	1.160000E+00	0.000000E+00	3.672652E-01	2.320000E-04	3.500000E-02	3.320000E-01
6.316300E+03	1.160000E+00	0.000000E+00	3.673841E-01	2.320000E-04	3.500000E-02	3.320000E-01
8.110300E+03	1.160000E+00	0.000000E+00	3.675556E-01	2.320000E-04	3.500000E-02	3.320000E-01
1.041400E+04	1.160000E+00	0.000000E+00	3.678024E-01	2.320000E-04	3.500000E-02	3.320000E-01
1.337200E+04	1.160000E+00	0.000000E+00	3.681564E-01	2.320000E-04	3.500000E-02	3.320000E-01
1.716900E+04	1.160000E+00	0.000000E+00	3.686620E-01	2.320000E-04	3.500000E-02	3.320000E-01
2.204600E+04	1.160000E+00	0.000000E+00	3.693814E-01	2.320000E-04	3.500000E-02	3.320000E-01
2.478800E+04	1.160000E+00	0.000000E+00	3.698150E-01	2.320000E-04	3.500000E-02	3.320000E-01

L-VALUE= 1 J-STATE= 3.00

ENERGY(EV)	SPACING	GAMMA INELAS	GAMMA TOTAL	GAMMA N NOT	GAMMA GAMMA	GAMMA FISS
6.450400E+01	1.000000E+00	0.000000E+00	1.620007E-01	2.000000E-04	3.500000E-02	1.270000E-01
8.290200E+01	1.000000E+00	0.000000E+00	1.620010E-01	2.000000E-04	3.500000E-02	1.270000E-01
1.156900E+02	1.000000E+00	0.000000E+00	1.620017E-01	2.000000E-04	3.500000E-02	1.270000E-01
1.485500E+02	1.000000E+00	0.000000E+00	1.620024E-01	2.000000E-04	3.500000E-02	1.270000E-01
1.907400E+02	1.000000E+00	0.000000E+00	1.620035E-01	2.000000E-04	3.500000E-02	1.270000E-01
2.449100E+02	1.000000E+00	0.000000E+00	1.620052E-01	2.000000E-04	3.500000E-02	1.270000E-01
3.144700E+02	1.000000E+00	0.000000E+00	1.620075E-01	2.000000E-04	3.500000E-02	1.270000E-01
4.037900E+02	1.000000E+00	0.000000E+00	1.620109E-01	2.000000E-04	3.500000E-02	1.270000E-01
5.184800E+02	1.000000E+00	0.000000E+00	1.620159E-01	2.000000E-04	3.500000E-02	1.270000E-01
6.657400E+02	1.000000E+00	0.000000E+00	1.620231E-01	2.000000E-04	3.500000E-02	1.270000E-01
8.548200E+02	1.000000E+00	0.000000E+00	1.620336E-01	2.000000E-04	3.500000E-02	1.270000E-01
1.097600E+03	1.000000E+00	0.000000E+00	1.620488E-01	2.000000E-04	3.500000E-02	1.270000E-01
1.409300E+03	1.000000E+00	0.000000E+00	1.620710E-01	2.000000E-04	3.500000E-02	1.270000E-01
1.809600E+03	1.000000E+00	0.000000E+00	1.621031E-01	2.000000E-04	3.500000E-02	1.270000E-01
2.323600E+03	1.000000E+00	0.000000E+00	1.621498E-01	2.000000E-04	3.500000E-02	1.270000E-01
2.983600E+03	1.000000E+00	0.000000E+00	1.622174E-01	2.000000E-04	3.500000E-02	1.270000E-01
3.831000E+03	1.000000E+00	0.000000E+00	1.623154E-01	2.000000E-04	3.500000E-02	1.270000E-01
4.919100E+03	1.000000E+00	0.000000E+00	1.624573E-01	2.000000E-04	3.500000E-02	1.270000E-01
6.316300E+03	1.000000E+00	0.000000E+00	1.626623E-01	2.000000E-04	3.500000E-02	1.270000E-01
8.110300E+03	1.000000E+00	0.000000E+00	1.629580E-01	2.000000E-04	3.500000E-02	1.270000E-01
1.041400E+04	1.000000E+00	0.000000E+00	1.633835E-01	2.000000E-04	3.500000E-02	1.270000E-01
1.337200E+04	1.000000E+00	0.000000E+00	1.639938E-01	2.000000E-04	3.500000E-02	1.270000E-01
1.716900E+04	1.000000E+00	0.000000E+00	1.648656E-01	2.000000E-04	3.500000E-02	1.270000E-01
2.204600E+04	1.000000E+00	0.000000E+00	1.661058E-01	2.000000E-04	3.500000E-02	1.270000E-01
2.478800E+04	1.000000E+00	0.000000E+00	1.668534E-01	2.000000E-04	3.500000E-02	1.270000E-01

ENERGY(EV)	SPACING	GAMMA INELAS	GAMMA TOTAL	GAMMA N NOT	GAMMA GAMMA	GAMMA FISS
6.450400E+01	1.000000E+00	0.000000E+00	3.210007E-01	2.000000E-04	3.500000E-02	2.860000E-01
8.290200E+01	1.000000E+00	0.000000E+00	3.210010E-01	2.000000E-04	3.500000E-02	2.860000E-01
1.156900E+02	1.000000E+00	0.000000E+00	3.210017E-01	2.000000E-04	3.500000E-02	2.860000E-01
1.485500E+02	1.000000E+00	0.000000E+00	3.210024E-01	2.000000E-04	3.500000E-02	2.860000E-01
1.907400E+02	1.000000E+00	0.000000E+00	3.210035E-01	2.000000E-04	3.500000E-02	2.860000E-01
2.449100E+02	1.000000E+00	0.000000E+00	3.210052E-01	2.000000E-04	3.500000E-02	2.860000E-01
3.144700E+02	1.000000E+00	0.000000E+00	3.210075E-01	2.000000E-04	3.500000E-02	2.860000E-01
4.037900E+02	1.000000E+00	0.000000E+00	3.210109E-01	2.000000E-04	3.500000E-02	2.860000E-01
5.184800E+02	1.000000E+00	0.000000E+00	3.210159E-01	2.000000E-04	3.500000E-02	2.860000E-01
6.657400E+02	1.000000E+00	0.000000E+00	3.210231E-01	2.000000E-04	3.500000E-02	2.860000E-01
8.548200E+02	1.000000E+00	0.000000E+00	3.210336E-01	2.000000E-04	3.500000E-02	2.860000E-01
1.097600E+03	1.000000E+00	0.000000E+00	3.210488E-01	2.000000E-04	3.500000E-02	2.860000E-01
1.409300E+03	1.000000E+00	0.000000E+00	3.210710E-01	2.000000E-04	3.500000E-02	2.860000E-01
1.809600E+03	1.000000E+00	0.000000E+00	3.211031E-01	2.000000E-04	3.500000E-02	2.860000E-01
2.323600E+03	1.000000E+00	0.000000E+00	3.211498E-01	2.000000E-04	3.500000E-02	2.860000E-01
2.983600E+03	1.000000E+00	0.000000E+00	3.212174E-01	2.000000E-04	3.500000E-02	2.860000E-01
3.831000E+03	1.000000E+00	0.000000E+00	3.213154E-01	2.000000E-04	3.500000E-02	2.860000E-01
4.919100E+03	1.000000E+00	0.000000E+00	3.214573E-01	2.000000E-04	3.500000E-02	2.860000E-01
6.316300E+03	1.000000E+00	0.000000E+00	3.216623E-01	2.000000E-04	3.500000E-02	2.860000E-01
8.110300E+03	1.000000E+00	0.000000E+00	3.219580E-01	2.000000E-04	3.500000E-02	2.860000E-01
1.041400E+04	1.000000E+00	0.000000E+00	3.223835E-01	2.000000E-04	3.500000E-02	2.860000E-01
1.337200E+04	1.000000E+00	0.000000E+00	3.229938E-01	2.000000E-04	3.500000E-02	2.860000E-01
1.716900E+04	1.000000E+00	0.000000E+00	3.238656E-01	2.000000E-04	3.500000E-02	2.860000E-01
2.204600E+04	1.000000E+00	0.000000E+00	3.251058E-01	2.000000E-04	3.500000E-02	2.860000E-01
2.478800E+04	1.000000E+00	0.000000E+00	3.258534E-01	2.000000E-04	3.500000E-02	2.860000E-01

L-VALUE= 1 J-STATE= 5.00

ENERGY(EV)	SPACING	GAMMA INELAS	GAMMA TOTAL	GAMMA N NOT	GAMMA GAMMA	GAMMA FISS
6.450400E+01	1.120000E+00	0.000000E+00	1.780004E-01	2.240000E-04	3.500000E-02	1.430000E-01
8.290200E+01	1.120000E+00	0.000000E+00	1.780006E-01	2.240000E-04	3.500000E-02	1.430000E-01
1.156900E+02	1.120000E+00	0.000000E+00	1.780009E-01	2.240000E-04	3.500000E-02	1.430000E-01
1.485500E+02	1.120000E+00	0.000000E+00	1.780014E-01	2.240000E-04	3.500000E-02	1.430000E-01
1.907400E+02	1.120000E+00	0.000000E+00	1.780020E-01	2.240000E-04	3.500000E-02	1.430000E-01
2.449100E+02	1.120000E+00	0.000000E+00	1.780029E-01	2.240000E-04	3.500000E-02	1.430000E-01
3.144700E+02	1.120000E+00	0.000000E+00	1.780042E-01	2.240000E-04	3.500000E-02	1.430000E-01
4.037900E+02	1.120000E+00	0.000000E+00	1.780061E-01	2.240000E-04	3.500000E-02	1.430000E-01
5.184800E+02	1.120000E+00	0.000000E+00	1.780089E-01	2.240000E-04	3.500000E-02	1.430000E-01
6.657400E+02	1.120000E+00	0.000000E+00	1.780129E-01	2.240000E-04	3.500000E-02	1.430000E-01
8.548200E+02	1.120000E+00	0.000000E+00	1.780188E-01	2.240000E-04	3.500000E-02	1.430000E-01
1.097600E+03	1.120000E+00	0.000000E+00	1.780273E-01	2.240000E-04	3.500000E-02	1.430000E-01
1.409300E+03	1.120000E+00	0.000000E+00	1.780397E-01	2.240000E-04	3.500000E-02	1.430000E-01
1.809600E+03	1.120000E+00	0.000000E+00	1.780577E-01	2.240000E-04	3.500000E-02	1.430000E-01
2.323600E+03	1.120000E+00	0.000000E+00	1.780839E-01	2.240000E-04	3.500000E-02	1.430000E-01
2.983600E+03	1.120000E+00	0.000000E+00	1.781218E-01	2.240000E-04	3.500000E-02	1.430000E-01
3.831000E+03	1.120000E+00	0.000000E+00	1.781768E-01	2.240000E-04	3.500000E-02	1.430000E-01
4.919100E+03	1.120000E+00	0.000000E+00	1.782561E-01	2.240000E-04	3.500000E-02	1.430000E-01
6.316300E+03	1.120000E+00	0.000000E+00	1.783709E-01	2.240000E-04	3.500000E-02	1.430000E-01
8.110300E+03	1.120000E+00	0.000000E+00	1.785365E-01	2.240000E-04	3.500000E-02	1.430000E-01
1.041400E+04	1.120000E+00	0.000000E+00	1.787747E-01	2.240000E-04	3.500000E-02	1.430000E-01
1.337200E+04	1.120000E+00	0.000000E+00	1.791165E-01	2.240000E-04	3.500000E-02	1.430000E-01
1.716900E+04	1.120000E+00	0.000000E+00	1.796047E-01	2.240000E-04	3.500000E-02	1.430000E-01
2.204600E+04	1.120000E+00	0.000000E+00	1.802992E-01	2.240000E-04	3.500000E-02	1.430000E-01

2.478800E+04 1.120000E+00 0.000000E+00 1.807179E+01 2.240000E-04 3.500000E-02 1.430000E-01

AVERAGE SCATTERING CROSS-SECTION

NEUTRON ENERGY(EV)	S-WAVE SIGMANN	P-WAVE SIGMANN	D-WAVE SIGMANN	TOTAL SIGMANN
6.450400E+01	1.128573E+01	1.037337E-06	0.000000E+00	1.128573E+01
8.290200E+01	1.143264E+01	1.713097E-06	0.000000E+00	1.143264E+01
1.156900E+02	1.162549E+01	3.335388E-06	0.000000E+00	1.162549E+01
1.485500E+02	1.195781E+01	5.497965E-06	0.000000E+00	1.195782E+01
1.907400E+02	1.182793E+01	9.061713E-06	0.000000E+00	1.182794E+01
2.449100E+02	1.218540E+01	1.493374E-05	0.000000E+00	1.218542E+01
3.144700E+02	1.154287E+01	2.460894E-05	0.000000E+00	1.154289E+01
4.037900E+02	1.139494E+01	4.054633E-05	0.000000E+00	1.139498E+01
5.184800E+02	1.163924E+01	6.679261E-05	0.000000E+00	1.163930E+01
6.657400E+02	1.172709E+01	1.099958E-04	0.000000E+00	1.172720E+01
8.548200E+02	1.171957E+01	1.810774E-04	0.000000E+00	1.171975E+01
1.097600E+03	1.181736E+01	2.979523E-04	0.000000E+00	1.181765E+01
1.409300E+03	1.144809E+01	4.899263E-04	0.000000E+00	1.144858E+01
1.809600E+03	1.141025E+01	8.049817E-04	0.000000E+00	1.141105E+01
2.323600E+03	1.128002E+01	1.321153E-03	0.000000E+00	1.128134E+01
2.983600E+03	1.123670E+01	2.165018E-03	0.000000E+00	1.124086E+01
3.831000E+03	1.127680E+01	3.542597E-03	0.000000E+00	1.128034E+01
4.919100E+03	1.113067E+01	5.774555E-03	0.000000E+00	1.113644E+01
6.316300E+03	1.102949E+01	9.384230E-03	0.000000E+00	1.103887E+01
8.110300E+03	1.093151E+01	1.517711E-02	0.000000E+00	1.094668E+01
1.041400E+04	1.086353E+01	2.439221E-02	0.000000E+00	1.088793E+01
1.337200E+04	1.076806E+01	3.888194E-02	0.000000E+00	1.080694E+01
1.716900E+04	1.063184E+01	6.132624E-02	0.000000E+00	1.069316E+01
2.204600E+04	1.046647E+01	9.548830E-02	0.000000E+00	1.056196E+01
2.478800E+04	1.041326E+01	1.169041E-01	0.000000E+00	1.053017E+01

AVERAGE CAPTURE CROSS-SECTION

NEUTRON ENERGY(EV)	S-WAVE SIGMANGAMMA	P-WAVE SIGMANGAMMA	D-WAVE SIGMANGAMMA	TOTAL SIGMANGAMMA
6.450400E+01	1.213343E+01	2.245308E-02	0.000000E+00	1.215589E+01
8.290200E+01	1.213746E+01	2.545272E-02	0.000000E+00	1.216291E+01
1.156900E+02	1.205822E+01	3.006377E-02	0.000000E+00	1.208829E+01
1.485500E+02	1.280140E+01	3.406232E-02	0.000000E+00	1.283546E+01
1.907400E+02	1.026890E+01	3.859076E-02	0.000000E+00	1.030749E+01
2.449100E+02	9.670739E+00	4.371861E-02	0.000000E+00	9.714457E+00
3.144700E+02	6.519591E+00	4.952469E-02	0.000000E+00	6.569116E+00
4.037900E+02	5.157919E+00	5.609663E-02	0.000000E+00	5.214016E+00
5.184800E+02	4.972499E+00	6.353244E-02	0.000000E+00	5.036032E+00
6.657400E+02	5.006695E+00	7.194106E-02	0.000000E+00	5.078836E+00
8.548200E+02	4.717705E+00	8.144327E-02	0.000000E+00	4.799149E+00
1.097600E+03	4.358181E+00	9.217137E-02	0.000000E+00	4.450352E+00
1.409300E+03	2.998975E+00	1.042668E-01	0.000000E+00	3.103242E+00
1.809600E+03	2.576139E+00	1.178838E-01	0.000000E+00	2.694023E+00
2.323600E+03	2.034650E+00	1.331738E-01	0.000000E+00	2.167824E+00

2.983600E+03	1.774552E+00	1.502853E-01	0.000000E+00	1.924
3.831000E+03	1.656170E+00	1.693456E-01	0.000000E+00	1.825
4.919100E+03	1.338019E+00	1.904431E-01	0.000000E+00	1.528
6.316300E+03	1.118608E+00	2.135899E-01	0.000000E+00	1.332
8.110300E+03	9.401374E-01	2.386737E-01	0.000000E+00	1.178
1.041400E+04	8.303611E-01	2.654006E-01	0.000000E+00	1.095
1.337200E+04	7.228342E-01	2.932136E-01	0.000000E+00	1.016
1.716900E+04	6.079728E-01	3.212203E-01	0.000000E+00	9.291
2.204600E+04	4.986953E-01	3.481795E-01	0.000000E+00	8.468
2.478800E+04	4.873076E-01	3.600111E-01	0.000000E+00	8.473

AVERAGE FISSION CROSS-SECTION

NEUTRON ENERGY(EV)	S-WAVE SIGMAFISS	P-WAVE SIGMAFISS	D-WAVE SIGMAFISS	TOTAL SIGM
6.450400E+01	2.421250E+01	4.449103E-02	0.000000E+00	2.425
8.290200E+01	2.421285E+01	5.043514E-02	0.000000E+00	2.426
1.156900E+02	2.175032E+01	5.957274E-02	0.000000E+00	2.180
1.485500E+02	2.145637E+01	6.749699E-02	0.000000E+00	2.152
1.907400E+02	1.965362E+01	7.647193E-02	0.000000E+00	1.973
2.449100E+02	2.356960E+01	8.663586E-02	0.000000E+00	2.365
3.144700E+02	1.499316E+01	9.814573E-02	0.000000E+00	1.509
4.037900E+02	1.234818E+01	1.111765E-01	0.000000E+00	1.245
5.184800E+02	1.481730E+01	1.259246E-01	0.000000E+00	1.494
6.657400E+02	1.171999E+01	1.426094E-01	0.000000E+00	1.186
8.548200E+02	9.004881E+00	1.614760E-01	0.000000E+00	9.166
1.097600E+03	8.484518E+00	1.827964E-01	0.000000E+00	8.667
1.409300E+03	7.155726E+00	2.068663E-01	0.000000E+00	7.362
1.809600E+03	6.467422E+00	2.340166E-01	0.000000E+00	6.701
2.323600E+03	5.705139E+00	2.645890E-01	0.000000E+00	5.969
2.983600E+03	5.013612E+00	2.989440E-01	0.000000E+00	5.312
3.831000E+03	4.712044E+00	3.374391E-01	0.000000E+00	5.049
4.919100E+03	3.860386E+00	3.804160E-01	0.000000E+00	4.240
6.316300E+03	3.281264E+00	4.281555E-01	0.000000E+00	3.709
8.110300E+03	2.824327E+00	4.808212E-01	0.000000E+00	3.305
1.041400E+04	2.542653E+00	5.383927E-01	0.000000E+00	3.081
1.337200E+04	2.262384E+00	6.005414E-01	0.000000E+00	2.862
1.716900E+04	1.963987E+00	6.664918E-01	0.000000E+00	2.630
2.204600E+04	1.671071E+00	7.349421E-01	0.000000E+00	2.406
2.478800E+04	1.634810E+00	7.673340E-01	0.000000E+00	2.402