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A FORTRAN CODE FOR CROSS SECTION CALCULATIONS USING A STATISTICAL MODEL WITH PREEQUILIBRIUM EFFECTS

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B.P. n° 561 - 92542 Montrouge - France -

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ABSTRACT

This report is the description of a Fortran code for statistical model calculations of (i,xn), (i,xnp), (i,xnα), (i,p) and (i,α) reactions with inclusion of preequilibrium emission in a closed form. The incident particle i can be a neutron, a proton, a deuteron, a triton or an alpha-particle. Besides these cross sections, this code gives the various widths and the primary and secondary neutron spectra.

MSPQ : PROGRAMME FORTRAN DE CALCUL DE SECTIONS EFFICACES PAR MODELE STATISTIQUE AVEC EFFETS DE PREEQUILIBRE

RESUME

Ce programme calcule par modèle statistique les sections efficaces des réactions (i,xn), (i,xnp), (i,xnα), (i,p) et (i,α) en tenant compte de l'émission de préequilibre sous une forme approchée. La particule incidente peut être un neutron, un proton, un deuteron, un triton ou une particule α. Le programme donne également les différentes largeurs calculées ainsi que les spectres des neutrons primaires et secondaires.

1 - INTRODUCTION

The main features of the FORTRAN programme MSPQ are described in this report. The code was written in order to calculate the cross sections of (i,xn), (i,xnp), (i,xnα), (i,p) and (i,α) reactions using the statistical model with inclusion of preequilibrium emission. The incident particle can be a neutron, a proton, a deuteron, a triton or an α-particle and the number of emitted neutrons (x) can vary from 1 to 3. Besides the above reaction cross sections, the neutron, proton, γ-rays and α-particle widths are tabulated.

The code gives also the neutron spectra of (i,n') and (i,2n) reactions.

The statistical model assumes the formation of a compound nucleus followed by the independent disintegration of the compound system into the products of the reaction. In this code we did not take into account the angular momentum and parity conservation; the preequilibrium effects were introduced in the close-form given in ref. [1].

The compound nucleus and the various residual nuclei can emit neutrons, protons, α-particles and γ-rays.

The compound nucleus formation cross section (for incident particles) and the inverse reaction cross sections (for the emitted particles) needed in these calculations are input data.

The level density formulae follow the Fermi-gas formalism of Gilbert and Cameron [2].

This code was used to calculate the neutron cross sections of a set of Yttrium isotopes [3]. It was also employed without preequilibrium effects to compare the calculated and measured (n,2n) cross sections of a set of nuclei [4].

This report contains the mathematical formulation and a detailed description of the program written in the FORTRAN IV language for an IBM 360/91 computer. Moreover, the input list and the output data of a calculation for a test run are included in the Appendix.

2 - THE STATISTICAL MODEL-FORMALISM

2-1- Cross sections

Following the statistical model the two steps of the reaction, the formation of the compound system and its disintegration, can be considered as separate processes.

In this code, the compound nucleus and the residual nuclei can decay by neutron, proton, α-particle and γ-ray emission. These various decay rates are characterized by the partial widths Γ_n, Γ_p, Γ_α and Γ_γ respectively. Their sum is the total width Γ_T.

For sake of simplicity, we give the mathematical formalism for the neutron induced cross sections only. Other incident particles can be treated in the same way, the only difference being the composite nucleus formation cross sections and the separation energy of the incident particle from this nucleus.

The neutron reaction cross section for the emission of a particle i (i = n,p,α,γ) can be written as :

$$\sigma(n,i) = \sigma_c \frac{\Gamma_i}{\sum_{i'} \Gamma_{i'}} \qquad (i' \equiv n,p,\alpha,\gamma) \qquad (1)$$

where σ_c is the composite nucleus formation cross section with the neutron as incident particle.

When several particles are emitted, the composite nucleus emits the first one, the resulting residual nucleus emits the second one and so on. Thus, the successive emission probabilities from these nuclei must be combined. In the code MSPQ, the cross section for the (n,xnγ) process is generally written in the form :

$$\sigma(n,xn\gamma) = \sigma_c(\varepsilon_n) \cdot \frac{\Gamma_n}{\Gamma_T}(E) \cdot P(E,xn) \qquad (2)$$

In this expression ε_n is the incident neutron energy, $\frac{\Gamma_n}{\Gamma_T}(E)$ is the total neutron emission probability from the composite nucleus excited at the energy E, and P(E,xn) is the relative probability that the composite

nucleus emits x neutrons and then γ-rays.

The following formulae are given by excluding any preequilibrium effect. The inclusion of these effects will be described in chapter 2-4.

The excitation energy of the compound nucleus is given by :

$$E = \varepsilon_n + S_{inc.} \tag{3}$$

where S_{inc} is the separation energy of the incident particle from the compound nucleus.

The relative probability P(E,xn) is written as :

$$P(E, xn) = \frac{\int_0^{E_{max}} d\varepsilon_1 \left[\varepsilon_1 \ \sigma_c(\varepsilon_1)\, \rho(E_1)\right] \frac{\Gamma_n}{\Gamma_T}(E_1)\, P(E_1, (x-1)n)}{\int_0^{E-S_1} d\varepsilon_1 \left[\varepsilon_1 \ \sigma_c(\varepsilon_1)\ \rho(E_1)\right]} \tag{4}$$

ε_1 is the center-of-mass kinetic energy of the first emitted neutron, $\rho(E_1)$ is the level density in the residual nucleus at excitation energy E_1 given by :

$$E_1 = E - S_1 - \varepsilon_1 \tag{5}$$

In equation 4, the quantities in brackets are the primary neutron spectra : $N(\varepsilon_1)$, E_{MAX} is the maximum available energy corresponding to the case when the "n" th residual nucleus is left in its ground state

$$E_{max} = E - \sum_{i=1}^{x} S_i \tag{6}$$

$S_i \equiv S_1, S_2, S_3 \ldots$ are the neutron separation energies for respectively the compound nucleus, the first residual nucleus and so on.

If we consider a (n,xnγ) reaction, the last residual nucleus can only emit a γ-ray, the relative probability is then written :

$$P(E_{x-1}, \gamma n) = \frac{\int_0^{E_{x-1} - S_x} \left[\varepsilon_x \, \sigma_c(\varepsilon_x) \, \rho(E_x) \right] \frac{\Gamma_\gamma}{\Gamma_T}(E_x) \, d\varepsilon_x}{\int_0^{E_{x-1} - S_x} \left[\varepsilon_x \, \sigma_c(\varepsilon_x) \, \rho(E_x) \right] d\varepsilon_x} \qquad (7)$$

For the (n,xnp) and the (n,xnα) reactions the above γ-ray width is replaced respectively by the proton Γ_p and the alpha Γ_α widths.

2-2- Widths

The various widths are proportional to the level densities of the residual nuclei involved in the process.

The γ-ray width is obtained assuming that all the radiation is of the electric dipole type, normalized to the experimental values Γ_γ^{exp} measured at neutron resonance energies [5]

$$\Gamma_\gamma(E) = \frac{C_\gamma}{\rho(E)} \int_0^E \varepsilon^3 \, \rho(E-\varepsilon) \, d\varepsilon \qquad (8)$$

In this expression ε is the γ-ray energy, ρ(E) and ρ(E-ε) are the level densities of the initial and final states of the nucleus respectively. C_γ is the normalization constant.

At excitation energies higher than the neutron separation energy, the total radiative width obeys the formalism of the giant dipole resonance [6] :

$$\Gamma_\gamma(E) = \frac{C'_\gamma}{\rho(E)} \int_0^E \frac{\varepsilon^4 \, \rho(E-\varepsilon) \, d\varepsilon}{\left(E_R^2 - \varepsilon^2\right)^2 - \varepsilon^2 \Gamma_R^2} \qquad (9)$$

where E_R is the giant resonance energy, Γ_R its width and C'_γ the normalization constant.

If the value of Γ_γ^{exp} is not given as input datum, it is calculated in the code from the empirical formula [5] :

$$\Gamma_\gamma(E=S) = \frac{12.7 \cdot T \cdot S^{0.15}}{A^{0.91}} \tag{10}$$

where T is the nuclear temperature (see section 2.3) and S the separation energy of a neutron from the nucleus of mass number A.

The neutron, proton and alpha widths have the following form :

$$\Gamma_{n,p,\alpha}(E) = \frac{(2s+1)}{\pi^2 \hbar^2} \mu \frac{1}{\rho(E)} \int_0^{E-S_{n,p,\alpha}} \left[\varepsilon \cdot \sigma_{inv}(\varepsilon)\, \rho(E - S_{n,p,\alpha} - \varepsilon) \right] d\varepsilon \tag{11}$$

In this expression s is the spin of the emitted particle, ε its center-of-mass kinetic energy and μ is the reduced mass in the exit channel n,p or α. $S_{n,p,\alpha}$ are respectively the neutron, proton or alpha separation energies from the compound nucleus, $\sigma_{inv}(\varepsilon)$ are the inverse reaction cross sections corresponding to each of these particles [for Γ_n, we have $\sigma_{inv}(\varepsilon) = \sigma_c(\varepsilon)$]. $\rho(E-S_{n,p,\alpha} - \varepsilon)$ are the level densities of the residual nuclei obtained in each case.

2-3- Level densities

According to ref. [2], the Fermi gas level density taking into account the shell corrections and the pairing energy is given by

$$\rho_2(E) = \frac{\sqrt{\pi}}{12} \frac{\exp\left[2\sqrt{a(E-\delta)}\right]}{a^{1/4}(E-\delta)^{5/4}} \frac{1}{\sqrt{2\pi}\,\sigma} \tag{12}$$

for excitation energies E higher than a transition energy E1 empirically evaluated. a is the level density parameter and δ the pairing energy.

σ is the spin cut-off parameter ; its empirical value is [2] :

$$\sigma^2 = 0.0888 \left[a(E-\delta)\right]^{1/2} A^{2/3} \tag{13}$$

where A is the mass number of the nucleus.

At excitation energies lower than E1, the level density has the form :

$$\rho_1(E) = \frac{1}{T} \exp\left(\frac{E-E_0}{T}\right) \tag{14}$$

where T is the nuclear temperature and E_0 an adjustable value.

In the code MSPQ, the level density parameter a can be given as input datum. If not, it is obtained from the formula of Gilbert and Cameron :

$$a = A\left[0.00917\, S_c + \begin{matrix} 0.142 \\ 0.120 \end{matrix}\right] \begin{matrix} \text{spherical nuclei} \\ \text{deformed nuclei} \end{matrix} \tag{15}$$

where S_c is the total shell correction for the nucleus A .

The transition energy E1 , the nuclear temperature T and the adjustable value E_0 can be given as input data or calculated in the code following the formulae of Gilbert and Cameron [2] :

$$E1 = 2.5 + \frac{150.}{A} + \delta \quad (\text{MeV})$$

$$T^{-1} = \sqrt{\frac{a}{(E1-\delta)}} - \frac{3}{2(E-\delta)} \quad (\text{MeV})^{-1} \tag{16}$$

In this latter case, the value of E_0 is obtained by matching the values of the level densities ρ_1 and ρ_2 at the excitation energy E1 .

2-4- Preequilibrium emission

The preequilibrium emission was introduced using the close-form given in ref. [1]. The primary neutron spectra $N(\varepsilon_1)$ in brackets in equation 4 are replaced by the expression

$$N(\varepsilon_1) = \left[\frac{(1 - R(\varepsilon_n))\, \varepsilon_1\, \sigma_c(\varepsilon_1)\, \rho(\varepsilon_1)}{\rho(E)} + \frac{8 g_r}{g_c^5 E^3} \frac{\varepsilon_1\, \sigma_c(\varepsilon_1)}{2\pi |M|^2} \sum_h h(h+1)^2 \left(\frac{g_r U}{g_c E} \right)^{2h-1} \right] \quad (17)$$

where the first term of the r-h-s is the "statistical" or "equilibrium" part of the spectrum and the second term is the preequilibrium component. The quantities g_c and g_r are the sum of the neutron and proton single-particle level spacings (near the Fermi level) of the compound and residual nuclei respectively ; they are related to $\underline{a}$ by

$$a = \frac{\pi^2 g}{6} \quad (18)$$

The symbol M represents the average matrix element of the two-body interactions. The reduction factor $[1-R(\varepsilon_n)]$ is introduced to take approximately into account the decrease of the compound nucleus formation cross sections when the preequilibrium emission is included. Because this code calculates simultaneously the preequilibrium and compound nucleus cross sections, we must introduce initial values and an energy dependence of $R(\varepsilon)$. We assumed, in a first approximation, a linear dependence of $R(\varepsilon)$ on ε:

$$R(\varepsilon) = (\alpha \varepsilon + \beta) / 100. \quad (19)$$

The initial values α_o and β_o of the coefficients α and β are input data which obey the relations :

$$\alpha_o \times \text{EKINI} + \beta_o = 0 \qquad \text{(a)}$$
$$\alpha_o \times \varepsilon_{no} + \beta_o = R(\varepsilon_{no}) \qquad \text{(b)} \quad (20)$$

The equation (a) results from the assumption $R(\varepsilon_n) = 0$ for $\varepsilon_n \leq$ EKINI, where EKINI is also an input datum. The other equation (b) results from the choice of R at a given energy ε_{no} (generally R(20) = 0.2).

The calculations of the (n,xn) cross sections are based on equations 2 and 4. The compound or "equilibrium" (n,n') cross sections are derived from the "equilibrium" part of the primary neutron spectrum given in equation 17 and the preequilibrium (n,n') cross sections are derived from its preequilibrium part. The incident energy is assumed to be low enough to neglect, in a first approximation, the preequilibrium components of the spectra of the second and third emitted neutrons (generally $\varepsilon \lesssim 20$ MeV for incident neutrons).

The neutron and proton widths (eq.11) are also modified so as to take into account the preequilibrium emission. In this case the neutron or proton spectrum $I(\varepsilon)$ in brackets in equation (11) is replaced by (cf. eq. (17))

$$I(\varepsilon) = \left[\frac{\varepsilon . \sigma_{inv}(\varepsilon)\, \rho(U)}{\rho(E)} + \frac{8 g_r}{g_c^5 E^3} \frac{\varepsilon_1 \sigma_{inv}(\varepsilon_1)}{2\pi |M_1|^2} \sum_k k(k+1)^2 \left(\frac{g_r U}{g_c E} \right)^{2k-1} \right] \quad (21)$$

Then, the calculations of the (n,p) and (n,α) cross sections are based on both equations 1 and 11.

However, when calculating (n,α) cross sections, the Γ_α width (eq. 11) does not include this preequilibrium correction.

The parameters α and β in equation 20 are adjusted using an iteration procedure so as the sum of all the "equilibrium" and preequilibrium cross sections calculated reproduce satisfactorily the optical model reaction cross sections $\sigma_c(\varepsilon_n)$.

The squared matrix element $|M|^2$ can be derived from adjustment onto the experimental ratio of the "equilibrium" and "preequilibrium" components in (i, n') spectra (i ≡ n, p, d, t, α) [7]. The corresponding calculated ratio is obtained on the basis of equation 17 where $|M|^2$ is found to be correctly defined at the first step of the iteration procedure.

The dependence of this ratio on the incident neutron energies is well enough reproduced by an exponential law :

$$RN_{(i,n')}(\varepsilon_n) \equiv \frac{\sigma^{exp}_{(i,n')\,preeq.}}{\sigma^{exp}_{(i,n')\,equil.}} = \exp\left[c_i \varepsilon_n + d_i \right] / 100. \quad (22)$$

The c_i and d_i coefficients are given as input data.

The programme also permits the calculation with the matrix element given by an empirical formula of the form given by Cline [8]

$$|M|^2 = \frac{KM2}{A^3 E} \tag{23}$$

In this case, the value of KM2 may be different from the one given by Cline [7] which is obtained in an other context. So, when the preequilibrium emission is calculated with an empirical value of $|M|^2$ (equation 23) it is recommended to determine a priori the order of magnitude of KM2 by using the experimental ratio of equation (22) for the nucleus under study or for a neighbouring nucleus.

3 - PROGRAMME

3-1- General description

The programme consists of a total of 8 subroutines.

1 -	Main routine	MSPQ
2 -	Subroutine	SEXION
3 -	"	CALPAS
4 -	"	LARG
5 -	"	PROD
6 -	"	FINT
7 -	"	ALINT
8 -	"	DENIV

The programme assumes the utilisation of the FORTRAN elementary function subroutines: DSQRT, DLOG, DEXP. It is written in double precision.

3-2- Detailed description of the specific routines

1) The main routine MSPQ reads in data and prints out the calculated cross sections and the various widths. It calls subroutines LARG and SEXION.

2) SEXION calculates the cross sections following equations 1 and 2. To do this, it determines the excitation energies of the compound and residual nuclei (eq. 3 and 5) and calls the subroutines CALPAS, PROD and FINT. It prints out the neutron spectra.

3) LARG. This subroutine calculates the widths of all the nuclei involved in the process for different excitation energies E_L following the equations 8, 9 and 11. The branching ratios needed at excitation energies different from E_L are obtained by interpolation of those calculated in this subroutine.

4) CALPAS calculates the integral bounds (eq. 4 and 7 for instance) and the integration steps.

5) PROD calculates the integrands of equations 4 and 7 for instance.

6) FINT integers simultaneously 4 integrands computed by PROD using the method of SIMPSON.

7) ALINT permits a parabolic interpolation of the various branching ratios calculated in the subroutine LARG. It is also used to interpolate

the input inverse reaction cross sections for various energies of the emitted particle.

8) DENIV computes the level densities following equations 12 and 14.

3-3- Input data specifications

The input deck of MSPQ runs as follow :

1) Card 1 : Various titles of the output (18 A4 format)

2) Card 2 : Format title (18 A4 format)

3) Card 3 : " "

4) Card 4 : Characteristic values of the compound nucleus and neutron spectra

Z, PGZ, SCZ, PASPE (6 E12.8)

Z Charge of the compound nucleus

PGZ pairing energy of the compound nucleus depending on Z

SCZ shell correction for the compound nucleus depending on Z

PASPE : Energy step of the output (i,2n) neutron spectrum. The maximum value of the number of steps is 1000. This limitation gives a minimum value for PASPE depending on the incident energy.

5) Card 5 : Control data card (24 I3)

NN, NU, INC, NEX, IQX, IFN, IFP, IFD, IFT, IFA, IFSPE

NN : number of nuclei (compound and residual nuclei of same Z) involved in the process. In MSPQ, the value of NN is 4

NU : number of nuclei needed for the calculation of all widths NU = NN + 1

INC : number of the chosen incident energies

NEX : number of energies at which the experimental (n,2n) cross sections are read. NEX can be nul.

IQX : datum concerning the preequilibrium emission
= 0 The matrix element $|M|^2$ (eq. 17) is calculated by the expression (23).

= 1 This element is obtained from the experimental ratio given by equation (22).

IFN = 0 the incident particle is not a neutron
= 1 " " is a neutron

IFP = 0 " " is not a proton
= 1 " " is a proton

IFD = 0 " " is not a deuteron
= 1 " " is a deuteron

IFT = 0 " " is not a triton
= 1 " " is a triton

IFA = 0 " " is not an alpha-particle
= 1 " " is an alpha-particle

IFSPE = 0 the spectra of the emitted neutrons are not printed
= 1 the neutron spectra are printed

6) NEX cards for the experimental (n,2n) cross sections. On each card :

EX(K), SEX(K), DEX(K) (6 E12.8) K = 1, NEX

EX(K) is the energy corresponding to the measured (n,2n) cross section

SEX(K) is the experimental (n,2n) cross section

DEX(K) is the experimental error. The maximum value of K is 50

7) NU x 3 cards giving some characteristic values of the compound and residual nuclei of same Z

1st card : A(I), S(I), PGAZ(I), SCAZ(I), BW(I), NEPS(I) (5E12.8,I3)
2nd card : DG(I), PN(I), HO(I), ER(I), GR(I) (6E12.8)
3rd card : E1(I), T(I), EO(I), SED(I), SET(I) (6E12.8)

I = 1, to NU
A(1) is the mass number of the compound nucleus
A(2) = A(1)-1 etc

A(I) Mass number of the compound and residual nuclei of the same charge Z.

S(I) Neutron separation energy from the nucleus A(I).

PGAZ(I) Pairing energy depending on the neutron number of the nucleus A(I).

SCAZ(I) Shell correction depending on the neutron number of the nucleus A(I).

BW(I) Proton separation energy from the nucleus A(I).

NEPS(I) Number of energies at which the neutron inverse reaction cross sections are given. The involved reaction is :

$$A(I) + n \rightarrow [A(I) + 1]$$

If NEPS(I) = 0, the inverse reaction cross section is that of the nucleus (I-1).
NEPS(1) must always be different from 0 ; the maximum value of NEPS(I) is 50.

DG(I) Experimental value of the radiative width at the neutron resonance energies, Γ_{γ}^{exp} of the A(I) nucleus.
If DG(I) is 0 in the input data, its value is deduced from the expression (10).

PN(I) Level density parameter of the A(I) nucleus.
If PN(I) is nul, its value is calculated by the code according to the formula (15).

HO(I) Alpha-particle separation energy from the A(I) nucleus.

ER(I) Giant dipole resonance energy of the A(I) nucleus

GR(I) Giant dipole resonance width of the A(I) nucleus

E1(I) Transition energy for the level density calculation (eq. 12-14). If E1(I) is 0, it is given by the empirical expression (16).

T(I) nuclear temperature. If T(I) = 0, the code computes it according the equation (16).

EO(I) Adjustable value in the formula (14). If EO(I) is 0, its value is computed according to the Gilbert and Cameron method (see section 2-3).

SED(I) Deuteron separation energy from the A(I) nucleus.

SET(I) Triton separation energy from the A(I) nucleus.

8) INC cards giving the chosen incident energies and the corresponding compound nucleus formation cross sections. On each card, we have

EINC(K), SIGEI(K) (6 E12.8) (K = 1, INC)

The maximum value of K is 35.

EINC(K) Incident energy in the laboratory system.

SIGEI(K) Compound nucleus formation cross section corresponding to EINC(K).

9) A variable number of cards depending on the different values of NEPS(I). These cards give the neutron inverse reaction cross sections of the A(I) nuclei. On each card there are :

EPS(I,K) , SIG(I,K)	(6 E12.8)	I = 1	K = 1 to NEPS(I)
		I = 2	"
		"	
		I = NU	"

EPS(I,K) Neutron energy corresponding to the given cross section of the neutron inverse reaction : $A(I-1) + n \rightarrow A(I)$. The index I is used for the nuclei and K for the energies. EPS(I,K) = 0 is excluded.

SIG(I,K) Neutron inverse reaction cross section in the laboratory system. Same reaction as above and same remarks about the indexes.

10) 1 card giving some characteristic values of the residual nuclei obtained after a proton emission. We find on this card : ZP, SCZP, PGZP (6 E12.8)

ZP is the charge of the residual nuclei after a proton emission ZP = Z - 1.

SCZP shell correction related to the charge ZP of these nuclei.

PGZP Pairing energy related to the charge ZP of these nuclei.

11) 5 cards relative to the residual nuclei obtained after a proton emission. On each card, there are :

SCNP(I), PGNP(I), DP(I), PP(I), NP(I) (6E12.8) (I = 1 to 5)

SCNP(I) Shell correction related to the neutron number of the nucleus obtained after a proton emission from the A(I) nucleus. The mass number of this residual nucleus AP(I) is given by : AP(I) = A(I) - 1 .

PGNP(I) Pairing energy related to the neutron number of the nucleus AP(I).

DP(I) This input data permits to normalize, if possible, the calculated sum of the cross sections of the reactions A(I) + n → AP(I) + p → i + X (i = all emitted particles and γ-rays) to the sum of the measured cross sections. DP(I) is the ratio

$$\left[\frac{\sum_i \sigma(n,pi)}{\sigma_c(E_n)}\right]_{\varepsilon_n = 14\ \mathrm{MeV}}$$ at the incident energy of 14 MeV.

If DP(I) = 0, there is no normalization.

PP(I) Level density parameter of the residual nuclei AP(I). If PP(I) = 0, the code computes it according to the equation (15).

NP(I) Number of energies at which the proton inverse reaction cross sections are given. The involved reaction is AP(I) + p → A(I). If NP(I) = 0, the inverse cross section is that of the nucleus AP(I-1). NP(1) can always be different from 0. The maximum value of NP(I) is 50.

12) a variable number of cards according to the different values of NP(I). These cards give the proton inverse reaction cross sections. On each card there are :

EPS(I,K), SIP(I,K)	(6E12.8)	I = 1	K = 1, NP(I)
		I = 2	"
		"	
		I = 5	"

EPS(I,K) Proton energy corresponding to the input cross sections of the proton inverse reaction : AP(I) + p → A(I). The index I is used for the nuclei and K for the energies. EPS(I,K) = 0 is excluded. The maximum value of K is 50.

SIP(I,K) Proton inverse reaction cross sections. See EPS(I,K) just above.

13) 1 card giving some characteristic values of the residual nuclei obtained after the emission of an alpha particle from the A(I) nuclei. There are on this card :

ZA, SCZA, PGZA (6E12.8)

ZA Charge of the nuclei obtained after emission of an alpha particle. ZA = Z - 2.

SCZA Shell correction related to the charge ZA.

PGZA Pairing energy related to the charge ZA.

14) 5 cards characterizing the above nuclei of charge ZA. On each card, there are :

SCNA(I), PGNA(I), DA(I), PA(I), NA(I) (6E12.8) (I = 1 to 5)

SCNA(I) Shell correction related to the neutron number of the nucleus obtained after an alpha-particle emission from the nucleus A(I). The mass number of this residual nucleus AA(I) is given by : AA(I) = A(I) - 4 .

PGNA(I) Pairing energy related to the neutron number of the nuclei AA(I).

DA(I) This data permits to normalize, if possible, the sum of the cross sections of the reactions A(I) + n → AA(I) + α → i + χ (i ≡ all emitted particles and γ-rays) to the measured cross sections. DA(I) is the ratio $\left[\frac{\sum_i \sigma(n,\alpha i)}{\sigma_c(\varepsilon_n)}\right]_{\varepsilon_n = 14 \text{ MeV}}$ at the incident energy of 14 MeV. If DA(I) = 0, there is no normalization.

PA(I) Level density parameter of the residual nucleus AA(I). If PA(I) = 0, it is computed by the code according to the eq. 15.

NA(I) Number of energies at which the alpha inverse reaction cross sections are given. This inverse reaction is : AA(I) + $\alpha \rightarrow$ A(I). If NA(I) = 0, the cross section is that of the nucleus AA(I-1). NA(1) can always be different from 0. The maximum value of NA(I) is 50.

15) A variable number of cards following the values of NA(I). These cards give the alpha inverse reaction cross sections. There are on each card :

EA(I,K), SIA(I,K)	(6E12.8)	I = 1	K = 1 to NA(I)
		I = 2	"
		"	
		I = 5	"

EA(I,K) Alpha particle incident energy in the reaction AA(I) + $\alpha \rightarrow$ A(I). The index I is used for the nuclei and K for the energies. EA(I,K) = 0 is excluded. The maximum value of K is 50.

SIA(I,K) Alpha inverse reaction cross section. See EA(I,K) just above.

16) 1 card concerning the preequilibrium emission

EKINI, AQ, BQ, AYI, BYI, FMM (6E12.8)

EKINI The preequilibrium emission is assumed 0 at incident energies lower than EKINI. The minimum value of EKINI is 5 MeV.

AQ Initial value of the α coefficient (equations (19) and (20)). This value is chosen to give $R(\varepsilon_n) = 0$ for ε_n = EKINI and generally $R(\varepsilon_n) = 20/100$ for ε_n = 20 MeV. Thus, if EKINI = 5 this initial value is generally 4/3.

BQ Initial value of the β coefficient of equations 19 and 20. The chosen value of $R(\varepsilon_n)$ given just above imply BQ = - 20/3.

AYI c_i coefficient of the equation (22) obtained from an adjustment to experimental (i,n') cross sections.

BYI d_i coefficient of the equation (22).

FMM This input datum is the numerator of the matrix element (eq. 23) FMM = KM_2. It gives the possibility to adjust the value of $|M|^2$.

3-4- Output

All the input data are printed out. Besides these data, the various cross sections, the partial widths and the neutron spectra are tabulated. The neutron spectra are normalized to 1.

A first set of results corresponds to a calculation without preequilibrium emission. The second set takes into account this emission.

A test run is given in Appendix including the list of the input data and the output.

4 - ONE SAMPLE CASE : ^{89}Y neutron cross-sections

As an example, the (n,xn), (n,xnp), (n,xnα), (n,p) and (n,α) cross sections of ^{89}Y are calculated at the incident energies : 16 and 18 MeV. The control data are for this sample :

NN = 4 NU = 5 INC = 2 NEX = 2 IQX = 1 IFN = 1 IFP = 0

IFD = 0 IFT = 0 IFA = 0 IFSPE = 1 .

The results are given in the Appendix. In these calculations (IQX = 1), the strength of the preequilibrium component compared to the equilibrium one has been derived from experimental (n,n') spectra (cf equ.(22)) [3]. As can be seen, the calculations are performed without and with preequilibrium effects. For ^{89}Y(n,2n), the results show that in the presence of preequilibrium mechanism the total (n,2n) cross section at 16 and 18 MeV is decreased by about 17,4%.

REFERENCES

[1] CLINE C.K., BLANN M., Nucl. Phys. A172 (1971) 225.

[2] GILBERT A., CAMERON A.G.W., Can. J. of Phys. 43 (1965) 1446.

[3] JARY J., Comm. to the Int. Conf. at Lowell (July 1976), and to be published.

[4] HOLUB E. et al, Contribution to the V Int. Symp. on Interactions of fast Neutrons with Nuclei, Gaussig, DDR (Nov. 1975).

PHILIS C. and YOUNG P.G., CEA Rep. CEA-R-4676 (1975).

PHILIS C., CEA Rep. CEA-R-4636 (1974).

PHILIS C. and YOUNG P.G., CEA Rep. CEA-R-4712 (1975).

[5] MALECKY H. et al, Sov. J. of Nucl. Phys. 13 (1971) 133.

[6] AXEL P., Phys. Rev. 126 (1962) 671.

[7] KALBACH-CLINE C., Nucl. Phys. A210 (1973) 590.

[8] DECOWSKI P. et al, Report ZFK 271 (1974) 71.

APPENDIX

SAMPLE CASE : ^{89}Y neutron cross-sections

NOTA

1°) In these results all energies are in MeV and cross-sections in barn.

2°) For sake of brevity the MSPQ listing is not included. The author will send it on request.

DATA LIST

```
PA('E0(' T(' P('E1('
(2(11X,' P(',F5.0,')='E15.8)/                                                    )
(  1P0,10X,' P(',F5.0,')='E15.8                                                  )
+39       +02+0       +00-166     +02+6       -01                                  Z PGZ
  4  5  2  2  1  1  0  0  0  0  1
+160      +02+105     +01
+180      +02+105     +01
+90       +02+686     +01+0       +00+1323    +02+75671   +01 26                 Y
+817      -01+1006    +02+6101    +01+17      +02+6       +01                    Y90
+4167     +01+8377    +00-1157    +01                                            Y90
+89       +02+11468   +02+93      +00+1288    +02+70672   +01                    Y
+2495     +00+8916    +01+795     +01+17      +02+6       +01                    Y89
+5115     +01+9081    +00-1181    +00                                            Y89
+88       +02+9376    +01+0       +00+1438    +02+6712    +01 37                 Y
+24184    +00+9562    +01+696     +01+17      +02+6       +01                    Y88
+537      +01+9289    +00-1591    +01                                            Y88
+87       +02+11819   +02+146     +01+1552    +02+5764    +01                    Y
+245      +00+9658    +01+646     +01+17      +02+6       +01                    Y87
+67036    +01+83237   +00+0       +00                                            Y87
+86       -02+9472    +01+0       +00+1656    +02+543     +01                    Y86
+245      +00+1029    +02+5408    +01+17      +02+6       +01                    Y86
+00       +00                                                                    Y86
+16       +02+15350   +01                                                        SCNYR9
+18       +02+15350   +01                                                        SCNYR9
+1        -02+6534    +01                                                        SCNYR9
+5        -02+3246    +01                                                        SCNYR9
+1        -01+2598    +01                                                        SCNYR9
+5        -01+2213    +01                                                        SCNYR9
+1        +00+2462    +01                                                        SCNYR9
+2        +00+2832    +01                                                        SCNYR9
+3        +00+2966    +01                                                        SCNYR9
+4        +00+2946    +01                                                        SCNYR9
+5        +00+2875    +01                                                        SCNYR9
+6        +00+27535   +01                                                        SCNYR9
+8        +00+25000   +01                                                        SCNYR9
+1        +01+23230   +01                                                        SCNYR9
+2        +01+22580   +01                                                        SCNYR9
+3        +01+21850   +01                                                        SCNYR9
+4        +01+19240   +01                                                        SCNYR9
+5        +01+17700   +01                                                        SCNYR9
+6        +01+17070   +01                                                        SCNYR9
+7        +01+17000   +01                                                        SCNYR9
+8        +01+17440   +01                                                        SCNYR9
+9        +01+17420   +01                                                        SCNYR9
+1        +02+17330   +01                                                        SCNYR9
+12       +02+15970   +01                                                        SCNYR9
+14       +02+1538700 +01                                                        SCNYR9
+16       +02+15350   +01                                                        SCNYR9
+18       +02+15350   +01                                                        SCNYR9
+20       +02+15180   +01                                                        SCNYR9
+1        -02+6704983 +01                                                        SC Y88
+5        -02+3296003 +01                                                        SC Y88
+1        -01+25840000+01                                                        SC Y88
+2        -01+21990000+01
+3        -01+21000000+01
+4        -01+20820000+01
+5        -01+20970000+01
+6        -01+21270000+01
+7        -01+21640000+01
```

+9	-01+22460000+01					
+1	+00+22870000+01					
+2	+00+26080000+01					
+3	+00+27420000+01					
+4	+00+27450000+01					
+5	+00+27000000+01					
+6	+00+26050000+01					
+7	+00+25020000+01					
+8	+00+24010000+01					
+9	+00+23130000+01					
+1	+01+22390000+01					
+15	+01+21140000+01					
+20	+01+22040000+01					
+25	+01+22460000+01					
+30	+01+21850000+01					
+40	+01+19400000+01					
+50	+01+17580000+01					
+60	+01+16990000+01					
+70	+01+17120000+01					
+80	+01+17330000+01					
+90	+01+17130000+01					
+10	+02+16790000+01					
+12	+02+15950000+01					
+14	+02+15380000+01					
+16	+02+15220000+01					SC Y88
+18	+02+15230000+01					SC Y88
+20	+02+15090000+01					SC Y88
+38	+02-1641	+02+124	+01+716	+00+18	+00	ZP SCZP
+1325	+02+0	+00+000	+00+1011	+02 11		SRE9
+128E	+02+93	+00+000	+00+8936	+01		SRE8
+143F	+02+00	+00+000	+00+10753	+02		SRE7
+1562	+02+146	+01+000	+00+1179	+02		SRE6
+1656	+02+000	+00+000	+00+1168	+02		SRE5
+989	+00+1722	-09				SPSRE9
+2967	+01+2395	-02				SPSRE9
+4944	+01+9957	-01				SPSRE9
+6922	+01+4130	+00				SPSRE9
+8900	+01+6855	+00				SPSRE9
+10878	+02+6479	+00				SPSRE9
+12856	+02+9630	+00				SPSRE9
+13844	+02+1012	+01				SPSRE9
+16811	+02+1117	+01				SPSRE9
+19778	+02+1178	+01				SPSRE9
+20000	+02+1173	+01				SPSRE9
+37	+02-1618	+02+000	+00+931	+00+93	-01	ZA SCZ
+1438	+02+00000	+00+00	+00+7422	+01 14		RB86
+1562	+02+14600	+01+00	+00+9754	+01		RB85
+1656	+02+00000	+00+00	+01+1037	+02		RB84
+1738	+02+15700	+01+00	+00+1037	+02		RB83
+1776	+02+25000	+00+00	+00			RB82
+10	+01+2412	-38				SARB86
+20	+01+1489	-20				SARBR6
+30	+01+4279	-13				SARBB6
+4871	+01+375	-08				ARBB6ADA
+5906	+01+767	-06				ARBB6ADA
+6941	+01+383	-04				ARBB6ADA
+9011	+01+734	-03				ARBB6ADA
+11080	+02+138	+00				ARBB6ADA
+13150	+02+459	+00				ARBB6ADA
+14599	+02+6740	-01				ARBB6ADA

```
+15220   +02+756      +00                                                ARBR4ADA
+17290   +02+984      +00                                                ARBR6ADA
+19359   +02+116      +01                                                ARB36ADA
+21429   +02+130      +01                                                ARB36ADA
+5       +01+13333333+01-00000000+01+197702  +00+32352   +00+19      +03  EKINI
```

LARGEURS GAMMA ET PARAMETRES DE LA RESONANCE GEANTE — GAMMA WIDTHS AND GIANT RESONANCE PARAMETERS

A	GG/GT	ER	GR
0.900000000 02	0.817000000-01	0.170000000 02	0.600000000 01
0.890000000 02	0.249500000 00	0.170000000 02	0.600000000 01
0.880000000 02	0.241840000 00	0.170000000 02	0.600000000 01
0.870000000 02	0.245000000 00	0.170000000 02	0.600000000 01
0.860000000 02	0.245000000 00	0.170000000 02	0.600000000 01

SECTIONS EFFICACES DES PROTONS — PROTON CROSS SECTIONS

0.989000000 00	0.172200000-09
0.296700000 01	0.239500000-02
0.494400000 01	0.995700000-01
0.692700000 01	0.413000000 00
0.890000000 01	0.625500000 00
0.108780000 02	0.847900000 00
0.128560000 02	0.963000000 00
0.138440000 02	0.101200000 01
0.168110000 02	0.111700000 01
0.197780000 02	0.117800000 01
0.200000000 02	0.117800000 01

SECTIONS EFFICACES DES ALPHAS — ALPHA CROSS SECTIONS

0.100000000 01	0.241200000-38
0.200000000 01	0.148900000-20
0.300000000 01	0.427900000-13
0.487100000 01	0.375000000-08
0.590600000 01	0.767000000-06
0.694100000 01	0.385000000-04
0.901100000 01	0.734000000-03
0.110800000 02	0.138000000 00
0.131500000 02	0.459000000 00
0.145990000 02	0.674000000-01
0.152200000 02	0.756000000 00
0.172900000 02	0.984000000 00
0.193590000 02	0.110000000 01
0.214290000 02	0.130000000 01

CARACTERISTIQUES DES RESIDUELS PROTONS — PROTON RESIDUAL CHARACTERISTICS

Zp= 38. S(Z)=-0.104100 02 PG(Z)= 0.124000 01

VALEURS DE SC(N) ET DE PG(N)

A	SC(N)	PG(N)	GP/GT EXP
0.890000000 02	0.132300000 02	0.0	0.0
0.880000000 02	0.128800000 02	0.930000000 00	0.0
0.870000000 02	0.145600000 02	0.0	0.0
0.860000000 02	0.156200000 02	0.140000000 01	0.0
0.850000000 02	0.165600000 02	0.0	0.0

CARACTERISTIQUES DES RESIDUELS ALPHAS — ALPHA RESIDUAL CHARACTERISTICS

ZA= 37. S(Z)=-0.101800 02 PG(Z)= 0.0

VALEURS DE SC(N) ET DE PG(N)

A	SC(N)	PG(N)	GA/GT EXP

0.860000000D 02	0.143500000D 02	0.0	0.0
0.850000000D 02	0.150200000D 02	0.140000000D 01	0.0
0.840000000D 02	0.165000000D 02	0.0	0.0
0.830000000D 02	0.173800000D 02	0.157000000D 01	0.0
0.820000000D 02	0.177600000D 02	0.250000000D 00	0.0

PARAMETRES INITIAUX DU PREEQUILIBRE PREEQUILIBRIUM INITIAL PARAMETERS

IQX= 1 EKINI= 0.500D 01 AQ= 0.155D 01 BQ= -0.667D 01 AYI= 0.198D 00 BYI= 0.524D 00

PARAMETRES DE NIVEAUX DES RESIDUELS LEVEL PARAMETERS OF RESIDUALS

Z	NOMBRE DE MASSE	ENERGIE DE PAIRING	ENERGIE DE TRANSITION	PARAMETRE DE DENS.DE NIV.	TEMPERATURE NUCLEAIRE	EO
38	0.890000000D 02	0.124000000D 01	0.542539330D 01	0.101100000D 02	0.836251390D 00	0.651072460D-01
37	0.860000000D 02	0.0	0.424418600D 01	0.742200000D 01	0.103201660D 01	-0.395694600D 00
38	0.880000000D 02	0.217000000D 01	0.637454550D 01	0.898000000D 01	0.904843500D 00	0.110102250D 01
37	0.850000000D 02	0.146000000D 01	0.572470590D 01	0.976400000D 01	0.861043270D 00	0.265945050D 00
38	0.870000000D 02	0.124000000D 01	0.546413790D 01	0.107530000D 02	0.806195340D 00	-0.224395420D-01
37	0.840000000D 02	0.0	0.428571430D 01	0.103700000D 02	0.829512700D 00	-0.126874630D 01
38	0.860000000D 02	0.270000000D 01	0.694418600D 01	0.117900000D 02	0.761449910D 00	0.133413820D 01
37	0.830000000D 02	0.157000000D 01	0.587722690D 01	0.108700000D 02	0.806222250D 00	0.239812160D 00

Z	A	PAIRING ENERGY	TRANSITION ENERGY	LEVEL DENSITY PARAMETER	NUCLEAR TEMPERATURE	E_0

LA PARTICULE INCIDENTE EST UN NEUTRON
****

CALCUL SANS PREEQUILIBRE
****

THE INCIDENT PARTICLE IS A NEUTRON

CALCULATION WITHOUT PREEQUILIBRIUM

* PARTICULE INCIDENTE N SUR LE NOYAU Z= 39. A= 89.)
****

I	ENERGIE INCIDENTE	I	SIGMA-C(EI)	I
I	0.16000000D 02	I	0.15350000D 01	I
I	0.18000000D 02	I	0.15350000D 01	I

* LARGEURS NEUTRONS
****

NOYAU Z=39.A= 90.	I	E	I	GN	I	GN/(GN+GG+GP+GA)
	I	0.40000000D 01	I	0.0	I	0.0
	I	0.42500000D 01	I	0.0	I	0.0
	I	0.45000000D 01	I	0.0	I	0.0
	I	0.47500000D 01	I	0.0	I	0.0
	I	0.50000000D 01	I	0.0	I	0.0
	I	0.52500000D 01	I	0.0	I	0.0
	I	0.55000000D 01	I	0.0	I	0.0
	I	0.57500000D 01	I	0.0	I	0.0
	I	0.60000000D 01	I	0.0	I	0.0
	I	0.62500000D 01	I	0.0	I	0.0
	I	0.65000000D 01	I	0.0	I	0.0
	I	0.67500000D 01	I	0.0	I	0.0
	I	0.70000000D 01	I	0.58448185D 00	I	0.87100939D 00
	I	0.72500000D 01	I	0.45869213D 01	I	0.97942527D 00
	I	0.75000000D 01	I	0.10758167D 02	I	0.99026727D 00
	I	0.77500000D 01	I	0.17491475D 02	I	0.99331635D 00
	I	0.80000000D 01	I	0.24246774D 02	I	0.99478604D 00
	I	0.82500000D 01	I	0.30955820D 02	I	0.99552552D 00
	I	0.85000000D 01	I	0.37882645D 02	I	0.99594688D 00
	I	0.87500000D 01	I	0.44962213D 02	I	0.99627501D 00
	I	0.90000000D 01	I	0.52013892D 02	I	0.99653225D 00
	I	0.92500000D 01	I	0.59137588D 02	I	0.99663730D 00
	I	0.95000000D 01	I	0.66341318D 02	I	0.99674040D 00
	I	0.97500000D 01	I	0.73678116D 02	I	0.99684123D 00
	I	0.10000000D 02	I	0.81154048D 02	I	0.99685448D 00
	I	0.10750000D 02	I	0.10529500D 03	I	0.99497108D 00
	I	0.11500000D 02	I	0.13450300D 03	I	0.99685982D 00
	I	0.12250000D 02	I	0.17696627D 03	I	0.99683567D 00
	I	0.13000000D 02	I	0.28225784D 03	I	0.99729192D 00
	I	0.13750000D 02	I	0.41224681D 03	I	0.99745858D 00
	I	0.14500000D 02	I	0.57197777D 03	I	0.99749476D 00
	I	0.15250000D 02	I	0.74988722D 03	I	0.99738338D 00
	I	0.16000000D 02	I	0.93429034D 03	I	0.99712661D 00
	I	0.16750000D 02	I	0.11340162D 04	I	0.99653375D 00
	I	0.17500000D 02	I	0.13441556D 04	I	0.99570038D 00
	I	0.18250000D 02	I	0.15833635D 04	I	0.99447409D 00
	I	0.19000000D 02	I	0.18221193D 04	I	0.99265446D 00
	I	0.19750000D 02	I	0.20659840D 04	I	0.99067886D 00
	I	0.20500000D 02	I	0.23534091D 04	I	0.98805171D 00
	I	0.21250000D 02	I	0.26358728D 04	I	0.98567468D 00
	I	0.22000000D 02	I	0.29541542D 04	I	0.98280226D 00
	I	0.22750000D 02	I	0.32620584D 04	I	0.97940850D 00
	I	0.23500000D 02	I	0.35744909D 04	I	0.97621944D 00
	I	0.24250000D 02	I	0.38990134D 04	I	0.97238879D 00
	I	0.25000000D 02	I	0.42305239D 04	I	0.96819658D 00

TARGET NUCLEUS Z = 39, A = 89

NEUTRON WIDTHS

NUCLEUS
Z = 39, A = 90

NUCLEUS
Z = 39, A = 89

NOYAU	E	GN	GN/(GN+GG+GP+GA)
Z=39,A= 89.			
	0.400000000D 01	0.0	0.0
	0.425000000D 01	0.0	0.0
	0.450000000D 01	0.0	0.0
	0.475000000D 01	0.0	0.0
	0.500000000D 01	0.0	0.0
	0.525000000D 01	0.0	0.0
	0.550000000D 01	0.0	0.0
	0.575000000D 01	0.0	0.0
	0.600000000D 01	0.0	0.0
	0.625000000D 01	0.0	0.0
	0.650000000D 01	0.0	0.0
	0.675000000D 01	0.0	0.0
	0.700000000D 01	0.0	0.0
	0.725000000D 01	0.0	0.0
	0.750000000D 01	0.0	0.0
	0.775000000D 01	0.0	0.0
	0.800000000D 01	0.0	0.0
	0.825000000D 01	0.0	0.0
	0.850000000D 01	0.0	0.0
	0.875000000D 01	0.0	0.0
	0.900000000D 01	0.0	0.0
	0.925000000D 01	0.0	0.0
	0.950000000D 01	0.0	0.0
	0.975000000D 01	0.0	0.0
	0.100000000D 02	0.0	0.0
	0.102500000D 02	0.0	0.0
	0.115000000D 02	0.107053770D-01	0.391025960D-01
	0.122500000D 02	0.847949170D 01	0.912026882D 00
	0.130000000D 02	0.235285000D 02	0.947261930D 00
	0.137500000D 02	0.427572390D 02	0.955012020D 00
	0.145000000D 02	0.666623600D 02	0.958044560D 00
	0.152500000D 02	0.963577410D 02	0.958586030D 00
	0.160000000D 02	0.134993070D 03	0.958371250D 00
	0.167500000D 02	0.187551590D 03	0.957274920D 00
	0.175000000D 02	0.301017160D 03	0.960345690D 00
	0.182500000D 02	0.491927750D 03	0.962601710D 00
	0.190000000D 02	0.751370010D 03	0.962286800D 00

NUCLEUS
Z = 39, A = 88

NOYAU	E	GN	GN/(GN+GG+GP+GA)
Z=39,A= 88.			
	0.400000000D 01	0.0	0.0
	0.425000000D 01	0.0	0.0
	0.450000000D 01	0.0	0.0
	0.475000000D 01	0.0	0.0
	0.500000000D 01	0.0	0.0
	0.525000000D 01	0.0	0.0
	0.550000000D 01	0.0	0.0
	0.575000000D 01	0.0	0.0
	0.600000000D 01	0.0	0.0
	0.625000000D 01	0.0	0.0
	0.650000000D 01	0.0	0.0

0.67500000D 01	0.0	0.0	
0.70000000D 01	0.0	0.0	
0.72500000D 01	0.0	0.0	
0.75000000D 01	0.0	0.0	
0.77500000D 01	0.0	0.0	
0.80000000D 01	0.0	0.0	
0.82500000D 01	0.0	0.0	
0.85000000D 01	0.0	0.0	
0.87500000D 01	0.0	0.0	
0.90000000D 01	0.0	0.0	
0.92500000D 01	0.0	0.0	
0.95000000D 01	0.30677215D-01	0.99529673D-01	
0.97500000D 01	0.29267933D 00	0.43760149D 00	
0.10000000D 02	0.75035367D 00	0.67882605D 00	
0.10750000D 02	0.25850402D 01	0.81466982D 00	
0.11500000D 02	0.49895866D 01	0.83853896D 00	

NOYAU Z=39,A= 87.

E	GN	GN/(GN+GG+GP+GA)
0.40000000D 01	0.0	0.0
0.42500000D 01	0.0	0.0
0.45000000D 01	0.0	0.0
0.47500000D 01	0.0	0.0
0.50000000D 01	0.0	0.0
0.52500000D 01	0.0	0.0
0.55000000D 01	0.0	0.0
0.57500000D 01	0.0	0.0
0.60000000D 01	0.0	0.0
0.62500000D 01	0.0	0.0
0.65000000D 01	0.0	0.0
0.67500000D 01	0.0	0.0
0.70000000D 01	0.0	0.0
0.72500000D 01	0.0	0.0
0.75000000D 01	0.0	0.0
0.77500000D 01	0.0	0.0
0.80000000D 01	0.0	0.0
0.82500000D 01	0.0	0.0
0.85000000D 01	0.0	0.0
0.87500000D 01	0.0	0.0
0.90000000D 01	0.0	0.0
0.92500000D 01	0.0	0.0
0.95000000D 01	0.0	0.0
0.97500000D 01	0.0	0.0
0.10000000D 02	0.0	0.0

NUCLEUS

Z = 39, A = 87

* LARGEURS GAMMAS

GAMMA WIDTHS

NUCLEUS

Z = 39, A = 90

NOYAU	E	GG	GG/(GN+GG+GP+GA)
Z=39,A= 90,			
	0.40000000D 01	0.61055956D-01	0.10000000D 01
	0.42500000D 01	0.36192917D-01	0.10000000D 01
	0.45000000D 01	0.38268754D-01	0.10000000D 01
	0.47500000D 01	0.40552624D-01	0.10000000D 01
	0.50000000D 01	0.43162443D-01	0.10000000D 01
	0.52500000D 01	0.46335164D-01	0.10000000D 01
	0.55000000D 01	0.50275024D-01	0.10000000D 01
	0.57500000D 01	0.54499985D-01	0.10000000D 01
	0.60000000D 01	0.60152228D-01	0.10000000D 01
	0.62500000D 01	0.64895551D-01	0.10000000D 01
	0.65000000D 01	0.71208844D-01	0.10000000D 01
	0.67500000D 01	0.79455077D-01	0.10000000D 01
	0.70000000D 01	0.86557315D-01	0.12699061D 00
	0.72500000D 01	0.96357179D-01	0.20574728D-01
	0.75000000D 01	0.10573547D 00	0.97327338D-02
	0.77500000D 01	0.11769357D 00	0.66836531D-02
	0.80000000D 01	0.12708421D 00	0.52139553D-02
	0.82500000D 01	0.13910627D 00	0.44764794D-02
	0.85000000D 01	0.15416772D 00	0.40531188D-02
	0.87500000D 01	0.16814348D 00	0.37240753D-02
	0.90000000D 01	0.18074769D 00	0.34629421D-02
	0.92500000D 01	0.19864469D 00	0.33511012D-02
	0.95000000D 01	0.21555890D 00	0.32386493D-02
	0.97500000D 01	0.23078514D 00	0.31224488D-02
	0.10000000D 02	0.25167670D 00	0.30914667D-02
	0.10750000D 02	0.30783030D 00	0.29146484D-02
	0.11500000D 02	0.37403136D 00	0.27765424D-02
	0.12250000D 02	0.44766159D 00	0.25216389D-02
	0.13000000D 02	0.53210202D 00	0.18800578D-02
	0.13750000D 02	0.62397301D 00	0.15097442D-02
	0.14500000D 02	0.72813560D 00	0.12698246D-02
	0.15250000D 02	0.84149753D 00	0.11192225D-02
	0.16000000D 02	0.96519186D 00	0.10301064D-02
	0.16750000D 02	0.11052171D 01	0.97122609D-03
	0.17500000D 02	0.12575581D 01	0.93155356D-03
	0.18250000D 02	0.14236381D 01	0.89415429D-03
	0.19000000D 02	0.16086794D 01	0.87637663D-03
	0.19750000D 02	0.18086287D 01	0.85895687D-03
	0.20500000D 02	0.20271107D 01	0.85116758D-03
	0.21250000D 02	0.22659897D 01	0.84735847D-03
	0.22000000D 02	0.25244537D 01	0.83984742D-03
	0.22750000D 02	0.28045234D 01	0.84203706D-03
	0.23500000D 02	0.31077032D 01	0.84873632D-03
	0.24250000D 02	0.34342207D 01	0.85647250D-03
	0.25000000D 02	0.37857462D 01	0.86640488D-03

NUCLEUS

Z = 39, A = 89

NOYAU	E	GG	GG/(GN+GG+GP+GA)
Z=39,A= 89,			
	0.40000000D 01	0.69061140D-01	0.10000000D 01
	0.42500000D 01	0.74012431D-01	0.10000000D 01

I	0.450000000D 01	I	0.78480507D-01	I	0.100000000D 01	I			
I	0.475000000D 01	I	0.82469313D-01	I	0.100000000D 01	I			
I	0.500000000D 01	I	0.86054588D-01	I	0.100000000D 01	I			
I	0.525000000D 01	I	0.49690846D-01	I	0.100000000D 01	I			
I	0.550000000D 01	I	0.51770558D-01	I	0.100000000D 01	I			
I	0.575000000D 01	I	0.53953271D-01	I	0.100000000D 01	I			
I	0.600000000D 01	I	0.56628204D-01	I	0.100000000D 01	I			
I	0.625000000D 01	I	0.60127773D-01	I	0.100000000D 01	I			
I	0.650000000D 01	I	0.63351645D-01	I	0.100000000D 01	I			
I	0.675000000D 01	I	0.68595779D-01	I	0.100000000D 01	I			
I	0.700000000D 01	I	0.74046225D-01	I	0.100000000D 01	I			
I	0.725000000D 01	I	0.79138798D-01	I	0.100000000D 01	I			
I	0.750000000D 01	I	0.86181034D-01	I	0.100000000D 01	I			
I	0.775000000D 01	I	0.95676984D-01	I	0.100000000D 01	I			
I	0.800000000D 01	I	0.10287990D 00	I	0.999999999D 00	I			
I	0.825000000D 01	I	0.11239725D 00	I	0.998950820D 00	I			
I	0.850000000D 01	I	0.11893254D 00	I	0.994040060D 00	I			
I	0.875000000D 01	I	0.12774796D 00	I	0.985013740D 00	I			
I	0.900000000D 01	I	0.13899238D 00	I	0.972609120D 00	I			
I	0.925000000D 01	I	0.14879427D 00	I	0.951943350D 00	I			
I	0.950000000D 01	I	0.16065514D 00	I	0.929284960D 00	I			
I	0.975000000D 01	I	0.16961662D 00	I	0.906436660D 00	I			
I	0.100000000D 02	I	0.18057936D 00	I	0.892733150D 00	I			
I	0.107500000D 02	I	0.21531425D 00	I	0.708666000D 00	I			
I	0.115000000D 02	I	0.25148834D 00	I	0.498337570D 00	I			
I	0.122500000D 02	I	0.30977260D 00	I	0.333181430D-01	I			
I	0.130000000D 02	I	0.37090029D 00	I	0.149325170D-01	I			
I	0.137500000D 02	I	0.44278280D 00	I	0.988985510D-02	I			
I	0.145000000D 02	I	0.52103759D 00	I	0.746814210D-02	I			
I	0.152500000D 02	I	0.61104982D 00	I	0.608010750D-02	I			
I	0.160000000D 02	I	0.70697736D 00	I	0.503329920D-02	I			
I	0.167500000D 02	I	0.81572946D 00	I	0.416353360D-02	I			
I	0.175000000D 02	I	0.93885541D 00	I	0.299526360D-02	I			
I	0.182500000D 02	I	0.10706818D 01	I	0.209510470D-02	I			
I	0.190000000D 02	I	0.12188465D 01	I	0.156098850D-02	I			

NUYAU
Z=39,A= 88.

I	E	I	GG	I	GG/(GN+GG+GP+GA)	I
I		I		I		I
I	0.400000000D 01	I	0.11455242D 00	I	0.100000000D 01	I
I	0.425000000D 01	I	0.12283749D 00	I	0.100000000D 01	I
I	0.450000000D 01	I	0.13057257D 00	I	0.100000000D 01	I
I	0.475000000D 01	I	0.13755544D 00	I	0.100000000D 01	I
I	0.500000000D 01	I	0.14380412D 00	I	0.100000000D 01	I
I	0.525000000D 01	I	0.14955174D 00	I	0.100000000D 01	I
I	0.550000000D 01	I	0.86417128D-01	I	0.100000000D 01	I
I	0.575000000D 01	I	0.89768224D-01	I	0.100000000D 01	I
I	0.600000000D 01	I	0.93643300D-01	I	0.100000000D 01	I
I	0.625000000D 01	I	0.96420091D-01	I	0.100000000D 01	I
I	0.650000000D 01	I	0.10305860D 00	I	0.100000000D 01	I
I	0.675000000D 01	I	0.11016797D 00	I	0.100000000D 01	I
I	0.700000000D 01	I	0.11779204D 00	I	0.100000000D 01	I
I	0.725000000D 01	I	0.12503317D 00	I	0.100000000D 01	I
I	0.750000000D 01	I	0.13721914D 00	I	0.999999996D 00	I
I	0.775000000D 01	I	0.14911986D 00	I	0.999937288D 00	I
I	0.800000000D 01	I	0.15970628D 00	I	0.997482010D 00	I
I	0.825000000D 01	I	0.17410754D 00	I	0.991148490D 00	I

NUCLEUS

Z = 39, A = 88

0.850000000D 01	0.18663225D 00	0.98075858D 00
0.875000000D 01	0.20521102D 00	0.96546424D 00
0.900000000D 01	0.21744837D 00	0.94353013D 00
0.925000000D 01	0.22899741D 00	0.91897305D 00
0.950000000D 01	0.24975420D 00	0.81030677D 00
0.975000000D 01	0.27061547D 00	0.45084326D 00
0.100000000D 02	0.29740311D 00	0.26905310D 00
0.107500000D 02	0.37407905D 00	0.11789020D 00
0.115000000D 02	0.45356324D 00	0.76224812D-01

NUCLEUS

Z = 39, A.= 87

NOYAU Z=39,A= 87.	E	GG	GG/(GN+GG+GP+GA)
	0.400000000D 01	0.68078558D-01	0.10000000D 01
	0.425000000D 01	0.72849564D-01	0.10000000D 01
	0.450000000D 01	0.76353386D-01	0.10000000D 01
	0.475000000D 01	0.79760603D-01	0.10000000D 01
	0.500000000D 01	0.82558079D-01	0.10000000D 01
	0.525000000D 01	0.84965424D-01	0.10000000D 01
	0.550000000D 01	0.87022271D-01	0.10000000D 01
	0.575000000D 01	0.88708254D-01	0.10000000D 01
	0.600000000D 01	0.90241577D-01	0.10000000D 01
	0.625000000D 01	0.91478065D-01	0.99999999D 00
	0.650000000D 01	0.92510609D-01	0.99999997D 00
	0.675000000D 01	0.52481907D-01	0.99999995D 00
	0.700000000D 01	0.54832926D-01	0.99166819D 00
	0.725000000D 01	0.57580910D-01	0.96498696D 00
	0.750000000D 01	0.61237468D-01	0.92262039D 00
	0.775000000D 01	0.65015684D-01	0.86830928D 00
	0.800000000D 01	0.71006406D-01	0.79585652D 00
	0.825000000D 01	0.77600330D-01	0.73425591D 00
	0.850000000D 01	0.83878597D-01	0.68344476D 00
	0.875000000D 01	0.92738980D-01	0.65116976D 00
	0.900000000D 01	0.10074070D 00	0.57520257D 00
	0.925000000D 01	0.11188594D 00	0.47965374D 00
	0.950000000D 01	0.12158620D 00	0.39325913D 00
	0.975000000D 01	0.13476756D 00	0.33055472D 00
	0.100000000D 02	0.14596814D 00	0.29272577D 00

* LARGEURS PROTONS ET ALPHAS
****

NOYAU	E	GP
Z=39,A= 90.		
	0.400000000D 01	0.0
	0.425000000D 01	0.0
	0.450000000D 01	0.0
	0.475000000D 01	0.0
	0.500000000D 01	0.0
	0.525000000D 01	0.0
	0.550000000D 01	0.0
	0.575000000D 01	0.0
	0.600000000D 01	0.0
	0.625000000D 01	0.0
	0.650000000D 01	0.0
	0.675000000D 01	0.0
	0.700000000D 01	0.0
	0.725000000D 01	0.0
	0.750000000D 01	0.0
	0.775000000D 01	0.379309030D-11
	0.800000000D 01	0.426912530D-10
	0.825000000D 01	0.144533680-09
	0.850000000D 01	0.319001750-09
	0.875000000D 01	0.412898340-04
	0.900000000D 01	0.250898040-03
	0.925000000D 01	0.688040820-03
	0.950000000D 01	0.159423790-02
	0.975000000D 01	0.266426220-02
	0.100000000D 02	0.440082340-02
	0.107500000D 02	0.120691550-01
	0.115000000D 02	0.490646000-01
	0.122500000D 02	0.114089780 00
	0.130000000D 02	0.234305060 00
	0.137500000D 02	0.420146300 00
	0.145000000D 02	0.707079430 00
	0.152500000D 02	0.112425970 01
	0.160000000D 02	0.171495410 01
	0.167500000D 02	0.280278510 01
	0.175000000D 02	0.447251490 01
	0.182500000D 02	0.724811530 01
	0.190000000D 02	0.110718390 02
	0.197500000D 02	0.175207900 02
	0.205000000D 02	0.259784520 02
	0.212500000D 02	0.354095050 02
	0.220000000D 02	0.482526300 02
	0.227500000D 02	0.644337670 02
	0.235000000D 02	0.821508660 02
	0.242500000D 02	0.105037200 03
	0.250000000D 02	0.132438090 03

NOYAU	E	GP
Z=39,A= 89.		
	0.400000000D 01	0.0
	0.425000000D 01	0.0

PROTON AND ALPHA WIDTHS

NUCLEUS

Z = 39, A = 90

GP/(GN+GG+GP+GA)	GA/(GN+GG+GP+GA)
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	0.16253523D-36
0.0	0.67506559D-37
0.0	0.26329094D-36
0.0	0.75212184D-37
0.0	0.48888304D-22
0.0	0.34696609D-21
0.21570063D-12	0.76072273D-21
0.17515181D-11	0.12601704D-20
0.46446990D-11	0.14174787D-15
0.83866581D-11	0.20297850D-14
0.91449546D-06	0.58760149D-14
0.48069463D-05	0.10997320D-13
0.11595454D-04	0.17039562D-11
0.20947627D-04	0.22359020D-10
0.36317205D-04	0.63766723D-10
0.54057445D-04	0.11982718D-09
0.11427512D-03	0.39628666D-09
0.36363732D-03	0.49284867D-08
0.64265786D-03	0.33417933D-07
0.82786201D-03	0.16250802D-06
0.10310893D-02	0.58344670D-06
0.12341503D-02	0.12675168D-05
0.14953154D-02	0.20309925D-05
0.18302944D-02	0.17993797D-04
0.24629893D-02	0.32034970D-04
0.33130773D-02	0.54993994D-04
0.45523741D-02	0.79378492D-04
0.63585863D-02	0.11057658D-03
0.83210016D-02	0.14118222D-03
0.10908144D-01	0.18898281D-03
0.13241254D-01	0.23650596D-03
0.16052917D-01	0.30497855D-03
0.19345754D-01	0.40370930D-03
0.22435999D-01	0.49582318D-03
0.26195601D-01	0.55913329D-03
0.30309746D-01	0.62726919D-03

NUCLEUS

Z = 39, A = 89

GP/(GN+GG+GP+GA)	GA/(GN+GG+GP+GA)
0.0	0.0
0.0	0.0

0.450000000D 01	0.0	0.0	0.0
0.475000000D 01	0.0	0.0	0.0
0.500000000D 01	0.0	0.0	0.0
0.525000000D 01	0.0	0.0	0.0
0.550000000D 01	0.0	0.0	0.0
0.575000000D 01	0.0	0.0	0.0
0.600000000D 01	0.0	0.0	0.0
0.625000000D 01	0.0	0.0	0.0
0.650000000D 01	0.0	0.0	0.0
0.675000000D 01	0.0	0.0	0.0
0.700000000D 01	0.0	0.0	0.0
0.725000000D 01	0.107812690-10	0.136232410-09	0.0
0.750000000D 01	0.121546330-09	0.141036050-08	0.0
0.775000000D 01	0.408042440-09	0.426479200-08	0.0
0.800000000D 01	0.895229660-09	0.870169680-08	0.757454790-40
0.825000000D 01	0.118048290-03	0.104917550-02	0.125193520-37
0.850000000D 01	0.715080580-03	0.595993740-02	0.627529410-37
0.875000000D 01	0.194359100-02	0.149862530-01	0.155084560-36
0.900000000D 01	0.391434150-02	0.273908850-01	0.221234510-21
0.925000000D 01	0.751138180-02	0.480566490-01	0.854538500-20
0.950000000D 01	0.122404630-01	0.707150410-01	0.315266180-19
0.975000000D 01	0.175080050-01	0.935633410-01	0.734667780-19
0.100000000D 02	0.216976120-01	0.107266850 00	0.350233470-14
0.107500000D 02	0.385161150-01	0.291334000 00	0.957749990-12
0.115000000D 02	0.230460870 00	0.468559830 00	0.473101060-08
0.122500000D 02	0.508150550 00	0.546550340-01	0.173277080-08
0.130000000D 02	0.939030580 00	0.378055520-01	0.423483420-08
0.137500000D 02	0.157139070 01	0.350980810-01	0.402503980-07
0.145000000D 02	0.239826880 01	0.344669530-01	0.343371570-06
0.152500000D 02	0.355094430 01	0.353328360-01	0.102400320-05
0.160000000D 02	0.515432410 01	0.365925010-01	0.295023830-05
0.167500000D 02	0.755395210 01	0.385558380-01	0.570695470-05
0.175000000D 02	0.114846140 02	0.366404100-01	0.186319670-04
0.182500000D 02	0.180153230 02	0.352522920-01	0.508902880-04
0.190000000D 02	0.281023960 02	0.360678520-01	0.843548920-04

NOYAU Z=39.A= 88.	E	GP	GP/(GN+GG+GP+GA)	GA/(GN+GG+GP+GA)
	0.400000000D 01	0.0	0.0	0.0
	0.425000000D 01	0.0	0.0	0.0
	0.450000000D 01	0.0	0.0	0.0
	0.475000000D 01	0.0	0.0	0.0
	0.500000000D 01	0.0	0.0	0.0
	0.525000000D 01	0.0	0.0	0.0
	0.550000000D 01	0.0	0.0	0.0
	0.575000000D 01	0.0	0.0	0.0
	0.600000000D 01	0.0	0.0	0.0
	0.625000000D 01	0.0	0.0	0.0
	0.650000000D 01	0.0	0.0	0.0
	0.675000000D 01	0.143901740-12	0.130020310-11	0.0
	0.700000000D 01	0.533634800-10	0.453031290-09	0.134522120-39
	0.725000000D 01	0.298441900-09	0.238690180-08	0.411806180-37
	0.750000000D 01	0.810314010-09	0.590525490-08	0.207982220-36
	0.775000000D 01	0.920325150-05	0.621156430-04	0.517932500-36
	0.800000000D 01	0.403153330-03	0.251798610-02	0.484262360-21
	0.825000000D 01	0.155487850-02	0.885151500-02	0.272569970-19

NUCLEUS

Z = 39, A = 88

0.85000000D 01	0.36615229D-02	0.19241422D-01	0.10583675D-18
0.87500000D 01	0.72090912D-02	0.34535764D-01	0.24311794D-18
0.90000000D 01	0.12916550D-01	0.56069870D-01	0.53165758D-14
0.92500000D 01	0.20196975D-01	0.81020953D-01	0.42504042D-12
0.95000000D 01	0.27790371D-01	0.90165553D-01	0.13218980D-11
0.97500000D 01	0.36948099D-01	0.61552460D-01	0.17427534D-11
0.10000000D 02	0.57612797D-01	0.52120845D-01	0.36109815D-10
0.10750000D 02	0.21399472D 00	0.67439974D-01	0.58230099D-08
0.11500000D 02	0.50718410D 00	0.85236211D-01	0.15281382D-07

NUYAU Z=39,A= 87,	E	GP	GP/(GN+GG+GP+GA)	GA/(GN+GG+GP+GA)
	0.40000000D 01	0.0	0.0	0.0
	0.42500000D 01	0.0	0.0	0.0
	0.45000000D 01	0.0	0.0	0.0
	0.47500000D 01	0.0	0.0	0.0
	0.50000000D 01	0.0	0.0	0.0
	0.52500000D 01	0.0	0.0	0.0
	0.55000000D 01	0.0	0.0	0.0
	0.57500000D 01	0.0	0.0	0.0
	0.60000000D 01	0.11788664D-09	0.13063451D-08	0.0
	0.62500000D 01	0.83269229D-09	0.91026440D-08	0.0
	0.65000000D 01	0.23496236D-08	0.25398423D-07	0.35416061D-39
	0.67500000D 01	0.25919582D-08	0.49387652D-07	0.10727205D-36
	0.70000000D 01	0.46069595D-03	0.83318099D-02	0.54860737D-36
	0.72500000D 01	0.20892331D-02	0.35013036D-01	0.13396205D-35
	0.75000000D 01	0.51359469D-02	0.77379607D-01	0.11665725D-20
	0.77500000D 01	0.98604982D-02	0.13169072D 00	0.62330925D-19
	0.80000000D 01	0.18212164D-01	0.20414348D 00	0.21495862D-18
	0.82500000D 01	0.26085344D-01	0.26574409D 00	0.45093933D-18
	0.85000000D 01	0.38850556D-01	0.31655524D 00	0.39961130D-14
	0.87500000D 01	0.49660073D-01	0.34863024D 00	0.65731865D-12
	0.90000000D 01	0.74398818D-01	0.42479743D 00	0.20165654D-11
	0.92500000D 01	0.12137804D 00	0.52034626D 00	0.30152088D-11
	0.95000000D 01	0.18758032D 00	0.60674087D 00	0.10668618D-09
	0.97500000D 01	0.27293365D 00	0.66944527D 00	0.43604926D-08
	0.10000000D 02	0.35268333D 00	0.70727422D 00	0.13050296D-07

NUCLEUS

Z = 39, A = 87

* SECTIONS EFFICACES INVERSES

INVERSE CROSS-SECTIONS

VALEURS DE LAGRANGE

EPS	SIGMA	EPS	SIGMA	EPS	SIGMA
0.90000000 02					
0.0	0.0	0.10000000D-02	0.65540000D 01	0.50000000D-02	0.32460000D 01
0.10000000D-01	0.25600000D 01	0.50000000D-01	0.22130000D 01	0.10000000D 00	0.24620000D 01
0.20000000D 00	0.23520000D 01	0.30000000D 00	0.29600000D 01	0.40000000D 00	0.29460000D 01
0.50000000D 00	0.28750000D 01	0.60000000D 00	0.27533000D 01	0.80000000D 00	0.25000000D 01
0.10000000D 01	0.23230000D 01	0.20000000D 01	0.22560000D 01	0.30000000D 01	0.21850000D 01
0.40000000D 01	0.19240000D 01	0.50000000D 01	0.17700000D 01	0.60000000D 01	0.17070000D 01

0.70000000D 01	0.17000000D 01	0.50000000D 01	0.17440000D 01	0.90000000D 01	0.17420000D 01
0.10000000D 02	0.17350000D 01	0.12000000D 02	0.15970000D 01	0.14000000D 02	0.15387600D 01
0.16000000D 02	0.15350000D 01	0.18000000D 02	0.15350000D 01	0.20000000D 02	0.15180000D 01
0.89000000D 02					
0.0	0.0	0.10000000D-02	0.65540000D 01	0.50000000D-02	0.32460000D 01
0.10000000D-01	0.25860000D 01	0.50000000D-01	0.22130000D 01	0.10000000D 00	0.24620000D 01
0.20000000D 00	0.28320000D 01	0.30000000D 00	0.29660000D 01	0.40000000D 00	0.29460000D 01
0.50000000D 00	0.28750000D 01	0.60000000D 00	0.27533000D 01	0.80000000D 00	0.25000000D 01
0.10000000D 01	0.23230000D 01	0.20000000D 01	0.22580000D 01	0.30000000D 01	0.21250000D 01
0.40000000D 01	0.19240000D 01	0.50000000D 01	0.17700000D 01	0.60000000D 01	0.17070000D 01
0.70000000D 01	0.17000000D 01	0.80000000D 01	0.17440000D 01	0.90000000D 01	0.17420000D 01
0.10000000D 02	0.17350000D 01	0.12000000D 02	0.15970000D 01	0.14000000D 02	0.15387600D 01
0.16000000D 02	0.15350000D 01	0.18000000D 02	0.15350000D 01	0.20000000D 02	0.15180000D 01
0.88000000D 02					
0.0	0.0	0.10000000D-02	0.67049830D 01	0.50000000D-02	0.32860030D 01
0.10000000D-01	0.25860000D 01	0.20000000D-01	0.21990000D 01	0.30000000D-01	0.21000000D 01
0.40000000D-01	0.20820000D 01	0.50000000D-01	0.20970000D 01	0.60000000D-01	0.21270000D 01
0.70000000D-01	0.21640000D 01	0.80000000D-01	0.22040000D 01	0.90000000D-01	0.22460000D 01
0.10000000D 00	0.22870000D 01	0.20000000D 00	0.26080000D 01	0.30000000D 00	0.27420000D 01
0.40000000D 00	0.27450000D 01	0.50000000D 00	0.27000000D 01	0.60000000D 00	0.26050000D 01
0.70000000D 00	0.25020000D 01	0.80000000D 00	0.24010000D 01	0.90000000D 00	0.23130000D 01
0.10000000D 01	0.22390000D 01	0.15000000D 01	0.21140000D 01	0.20000000D 01	0.22040000D 01
0.25000000D 01	0.22460000D 01	0.30000000D 01	0.21850000D 01	0.40000000D 01	0.19400000D 01
0.50000000D 01	0.17580000D 01	0.60000000D 01	0.16990000D 01	0.70000000D 01	0.17120000D 01
0.80000000D 01	0.17330000D 01	0.90000000D 01	0.17130000D 01	0.10000000D 02	0.16790000D 01
0.12000000D 02	0.15950000D 01	0.14000000D 02	0.15380000D 01	0.16000000D 02	0.15220000D 01
0.18000000D 02	0.15230000D 01	0.20000000D 02	0.15090000D 01		
0.87000000D 02					
0.0	0.0	0.10000000D-02	0.67049830D 01	0.50000000D-02	0.32860030D 01
0.10000000D-01	0.25860000D 01	0.20000000D-01	0.21990000D 01	0.30000000D-01	0.21000000D 01
0.40000000D-01	0.20820000D 01	0.50000000D-01	0.20970000D 01	0.60000000D-01	0.21270000D 01
0.70000000D-01	0.21640000D 01	0.80000000D-01	0.22040000D 01	0.90000000D-01	0.22460000D 01
0.10000000D 00	0.22870000D 01	0.20000000D 00	0.26080000D 01	0.30000000D 00	0.27420000D 01
0.40000000D 00	0.27450000D 01	0.50000000D 00	0.27000000D 01	0.60000000D 00	0.26050000D 01
0.70000000D 00	0.25020000D 01	0.80000000D 00	0.24010000D 01	0.90000000D 00	0.23130000D 01
0.10000000D 01	0.22390000D 01	0.15000000D 01	0.21140000D 01	0.20000000D 01	0.22040000D 01
0.25000000D 01	0.22460000D 01	0.30000000D 01	0.21850000D 01	0.40000000D 01	0.19400000D 01
0.50000000D 01	0.17580000D 01	0.60000000D 01	0.16990000D 01	0.70000000D 01	0.17120000D 01
0.80000000D 01	0.17330000D 01	0.90000000D 01	0.17130000D 01	0.10000000D 02	0.16790000D 01
0.12000000D 02	0.15950000D 01	0.14000000D 02	0.15380000D 01	0.16000000D 02	0.15220000D 01
0.18000000D 02	0.15230000D 01	0.20000000D 02	0.15090000D 01		

```
* ENERGIES DE SEPARATION DES NEUTRONS-PROTONS-ALPHAS                NEUTRON-PROTON-ALPHA SEPARATION ENERGIES
*****************************************************

     NOYAU        Z=39.A= 90.      S= 0.66600D 01      SP= 0.75671D 01      SA= 0.67610D 01      GG/GT= 0.81700D-01
     NOYAU        Z=39.A= 89.      S= 0.11468D 02      SP= 0.70672D 01      SA= 0.79500D 01      GG/GT= 0.24950D 00
     NOYAU        Z=39.A= 88.      S= 0.95760D 01      SP= 0.67120D 01      SA= 0.69600D 01      GG/GT= 0.24864D 00
     NOYAU        Z=39.A= 87.      S= 0.11819D 02      SP= 0.57640D 01      SA= 0.64600D 01      GG/GT= 0.24500D 00

* ENERGIES DE PAIRING                                                PAIRING ENERGIES
*********************

          P(  90.)= 0.0                        P(  89.)= 0.93000000D 00

          P(  88.)= 0.0                        P(  87.)= 0.14600000D 01

* PARAMETRES DE DENSITE DE NIVEAUX CALCULES                          CALCULATED LEVEL DENSITY PARAMETERS
*******************************************
            FORME EXP(2.*SQRT(PA*U))/U**1.5
          ******************************

         PA(  90.)= 0.10060000D 02            PA(  89.)= 0.89160000D 01

         PA(  88.)= 0.95620000D 01            PA(  87.)= 0.96580000D 01

* ENERGIES DE TRANSITION**FORME EXP((E-E0)/T)**CALCULEES             TRANSITION ENERGIES
*******************************************************

         E0(  90.)=-0.11570000D 01            E0(  89.)=-0.11810000D 00

         E0(  88.)=-0.15910000D 01            E0(  87.)= 0.61030003D 00

         E1(  90.)= 0.41670000D 01            E1(  89.)= 0.51150000D 01

         E1(  88.)= 0.53700000D 01            E1(  87.)= 0.67036000D 01

* TEMPERATURES DES NOYAUX CALCULEES                                  CALCULATED NUCLEAR TEMPERATURES
***********************************

          T(  90.)= 0.83770000D 00             T(  89.)= 0.90810000D 00

          T(  88.)= 0.92890000D 00             T(  87.)= 0.83237000D 00
```

SPECTRE NORMALISE DES NEUTRONS DE LA REACTION I-2N A L ENERGIE INCIDENTE E= 0.16000D 02 NORMALIZED NEUTRON SPECTRUM FROM (I,2n)

E	N(E)	E	N(E)	E	N(E)	E	N(E)
0.0	0.0	0.60674D-01	0.24422D-01	0.12135D 00	0.48846D-01	0.18202D 00	0.73269D-01
0.24270D 00	0.97690D-01	0.30337D 00	0.12211D 00	0.36404D 00	0.14652D 00	0.42472D 00	0.17092D 00
0.48539D 00	0.19532D 00	0.54607D 00	0.21972D 00	0.60674D 00	0.24164D 00	0.66742D 00	0.24371D 00
0.72809D 00	0.24578D 00	0.78876D 00	0.24785D 00	0.84944D 00	0.24992D 00	0.91011D 00	0.25196D 00
0.97079D 00	0.25405D 00	0.10315D 01	0.25612D 00	0.10921D 01	0.25619D 00	0.11528D 01	0.26625D 00
0.12135D 01	0.26211D 00	0.12742D 01	0.26321D 00	0.13348D 01	0.26431D 00	0.13955D 01	0.26542D 00
0.14562D 01	0.26652D 00	0.15169D 01	0.26762D 00	0.15775D 01	0.26873D 00	0.16382D 01	0.26983D 00
0.16989D 01	0.27093D 00	0.17596D 01	0.27204D 00	0.18202D 01	0.27164D 00	0.18809D 01	0.26525D 00
0.19416D 01	0.26486D 00	0.20022D 01	0.26146D 00	0.20629D 01	0.25807D 00	0.21236D 01	0.25468D 00
0.21843D 01	0.25128D 00	0.22449D 01	0.24789D 00	0.23056D 01	0.24450D 00	0.23663D 01	0.24110D 00
0.24270D 01	0.23724D 00	0.24876D 01	0.23280D 00	0.25483D 01	0.22835D 00	0.26090D 01	0.22390D 00
0.26697D 01	0.21945D 00	0.27303D 01	0.21501D 00	0.27910D 01	0.21056D 00	0.28517D 01	0.20611D 00
0.29124D 01	0.20167D 00	0.29730D 01	0.19722D 00	0.30337D 01	0.19278D 00	0.30944D 01	0.18703D 00
0.31551D 01	0.18176D 00	0.32157D 01	0.17648D 00	0.32764D 01	0.17121D 00	0.33371D 01	0.16593D 00
0.33978D 01	0.16065D 00	0.34584D 01	0.15538D 00	0.35191D 01	0.15011D 00	0.35798D 01	0.14483D 00
0.36404D 01	0.14032D 00	0.37011D 01	0.13619D 00	0.37618D 01	0.13206D 00	0.38225D 01	0.12792D 00
0.38831D 01	0.12379D 00	0.39438D 01	0.11966D 00	0.40045D 01	0.11553D 00	0.40652D 01	0.11140D 00
0.41258D 01	0.10727D 00	0.41865D 01	0.10314D 00	0.42472D 01	0.99862D-01	0.43079D 01	0.96824D-01
0.43685D 01	0.93786D-01	0.44292D 01	0.90748D-01	0.44899D 01	0.87711D-01	0.45506D 01	0.84673D-01
0.46112D 01	0.81636D-01	0.46719D 01	0.78598D-01	0.47326D 01	0.75560D-01	0.47933D 01	0.72523D-01
0.48539D 01	0.70236D-01	0.49146D 01	0.68043D-01	0.49753D 01	0.65851D-01	0.50360D 01	0.63658D-01
0.50966D 01	0.61465D-01	0.51573D 01	0.59273D-01	0.52180D 01	0.57080D-01	0.52787D 01	0.54887D-01
0.53393D 01	0.52694D-01	0.54000D 01	0.50502D-01	0.54607D 01	0.45955D-01	0.55213D 01	0.47408D-01
0.55820D 01	0.45861D-01	0.56427D 01	0.44314D-01	0.57034D 01	0.42768D-01	0.57640D 01	0.41221D-01
0.58247D 01	0.39674D-01	0.58854D 01	0.38127D-01	0.59461D 01	0.36580D-01	0.60067D 01	0.35033D-01
0.60674D 01	0.33978D-01	0.61281D 01	0.32875D-01	0.61888D 01	0.31768D-01	0.62494D 01	0.30663D-01
0.63101D 01	0.29558D-01	0.63708D 01	0.28454D-01	0.64315D 01	0.27349D-01	0.64921D 01	0.26244D-01
0.65528D 01	0.25139D-01	0.66135D 01	0.24107D-01	0.66742D 01	0.23331D-01	0.67348D 01	0.22555D-01
0.67955D 01	0.21778D-01	0.68562D 01	0.21002D-01	0.69169D 01	0.20226D-01	0.69775D 01	0.19449D-01
0.70382D 01	0.18673D-01	0.70989D 01	0.17897D-01	0.71596D 01	0.17120D-01	0.72202D 01	0.16425D-01
0.72809D 01	0.15891D-01	0.73416D 01	0.15357D-01	0.74022D 01	0.14824D-01	0.74629D 01	0.14290D-01
0.75236D 01	0.13756D-01	0.75843D 01	0.13222D-01	0.76449D 01	0.12689D-01	0.77056D 01	0.12155D-01
0.77663D 01	0.11621D-01	0.78270D 01	0.11152D-01	0.78876D 01	0.10764D-01	0.79483D 01	0.10376D-01
0.80090D 01	0.99892D-02	0.80697D 01	0.96002D-02	0.81303D 01	0.92122D-02	0.81910D 01	0.88242D-02
0.82517D 01	0.84363D-02	0.83124D 01	0.80485D-02	0.83730D 01	0.76603D-02	0.84337D 01	0.73373D-02
0.84944D 01	0.70644D-02	0.85551D 01	0.67954D-02	0.86157D 01	0.65245D-02	0.86764D 01	0.62555D-02
0.87371D 01	0.59826D-02	0.87978D 01	0.57117D-02	0.88584D 01	0.54407D-02	0.89191D 01	0.51696D-02
0.89798D 01	0.48938D-02	0.90404D 01	0.46887D-02	0.91011D 01	0.45089D-02	0.91618D 01	0.43292D-02
0.92225D 01	0.41495D-02	0.92831D 01	0.39697D-02	0.93438D 01	0.37900D-02	0.94045D 01	0.36103D-02
0.94652D 01	0.34305D-02	0.95258D 01	0.32508D-02	0.95865D 01	0.30711D-02	0.96472D 01	0.29396D-02
0.97079D 01	0.28220D-02	0.97685D 01	0.27045D-02	0.98292D 01	0.25867D-02	0.98899D 01	0.24690D-02
0.99506D 01	0.23514D-02	0.10011D 02	0.22337D-02	0.10072D 02	0.21161D-02	0.10133D 02	0.19984D-02
0.10193D 02	0.18808D-02	0.10254D 02	0.18000D-02	0.10315D 02	0.17238D-02	0.10375D 02	0.16476D-02
0.10436D 02	0.15714D-02	0.10497D 02	0.14952D-02	0.10557D 02	0.14191D-02	0.10618D 02	0.13429D-02
0.10679D 02	0.12667D-02	0.10737D 02	0.11905D-02	0.10800D 02	0.11143D-02	0.10861D 02	0.10657D-02
0.10921D 02	0.10171D-02	0.10982D 02	0.96842D-03	0.11045D 02	0.91778D-03	0.11103D 02	0.87115D-03
0.11164D 02	0.82252D-03	0.11225D 02	0.77388D-03	0.11285D 02	0.72525D-03	0.11346D 02	0.67662D-03
0.11407D 02	0.63029D-03	0.11467D 02	0.60241D-03	0.11528D 02	0.57454D-03	0.11589D 02	0.54666D-03
0.11649D 02	0.51379D-03	0.11710D 02	0.49091D-03	0.11771D 02	0.46803D-03	0.11831D 02	0.43516D-03
0.11892D 02	0.40728D-03	0.11953D 02	0.37941D-03	0.12013D 02	0.35412D-03	0.12074D 02	0.33786D-03
0.12135D 02	0.32164D-03	0.12196D 02	0.30540D-03	0.12256D 02	0.28916D-03	0.12317D 02	0.27292D-03
0.12378D 02	0.25668D-03	0.12438D 02	0.24045D-03	0.12499D 02	0.22421D-03	0.12560D 02	0.20797D-03
0.12620D 02	0.19250D-03	0.12681D 02	0.17859D-03	0.12742D 02	0.16467D-03	0.12802D 02	0.15076D-03
0.12863D 02	0.13684D-03	0.12924D 02	0.12292D-03	0.12984D 02	0.10901D-03	0.13045D 02	0.95091D-04
0.13106D 02	0.81175D-04	0.13166D 02	0.67258D-04	0.13227D 02	0.58294D-04	0.13288D 02	0.55518D-04
0.13348D 02	0.52742D-04	0.13409D 02	0.49967D-04	0.13470D 02	0.47191D-04	0.13530D 02	0.44415D-04
0.13591D 02	0.41640D-04	0.13652D 02	0.38864D-04	0.13712D 02	0.36088D-04	0.13773D 02	0.33313D-04

0.13334D 02	0.31249D-04	0.13894D 02	0.29755D-04	0.13955D 02	0.23261D-04	0.14014D 02	0.26768D-04
0.14076D 02	0.25274D-04	0.14137D 02	0.23780D-04	0.14190D 02	0.22236D-04	0.14252D 02	0.20793D-04
0.14319D 02	0.19299D-04	0.14380D 02	0.17805D-04	0.14440D 02	0.16771D-04	0.14501D 02	0.15966D-04
0.14562D 02	0.15161D-04	0.14622D 02	0.14357D-04	0.14683D 02	0.13552D-04	0.14744D 02	0.12708D-04
0.14804D 02	0.11743D-04	0.14865D 02	0.11138D-04	0.14926D 02	0.10334D-04	0.14987D 02	0.95289D-05
0.15047D 02	0.90139D-05	0.15108D 02	0.85817D-05	0.15169D 02	0.81496D-05	0.15229D 02	0.77174D-05
0.15290D 02	0.72852D-05	0.15351D 02	0.63530D-05	0.15411D 02	0.64208D-05	0.15472D 02	0.59886D-05
0.15533D 02	0.55564D-05	0.15593D 02	0.51242D-05	0.15654D 02	0.48663D-05	0.15715D 02	0.46302D-05
0.15775D 02	0.43941D-05	0.15836D 02	0.41580D-05				

SPECTRE NORMALISE DES NEUTRONS DE LA REACTION I-2N A L ENERGIE INCIDENTE E= 0.160000 02 NORMALIZED NEUTRON SPECTRUM FROM (I,2n)

E	N(E)	E	N(E)	E	N(E)	E	N(E)
0.0	0.0	0.506740-01	0.404910-01	0.121350 00	0.810850-01	0.182020 00	0.121340 00
0.242700 00	0.150240 00	0.303370 00	0.189010 00	0.364040 00	0.219330 00	0.424720 00	0.245430 00
0.485390 00	0.267370 00	0.546070 00	0.287590 00	0.606740 00	0.304150 00	0.667420 00	0.305040 00
0.728090 00	0.304900 00	0.788760 00	0.303350 00	0.849440 00	0.302730 00	0.910110 00	0.301750 00
0.970790 00	0.300850 00	0.103150 01	0.297760 00	0.109210 01	0.298160 00	0.115280 01	0.297010 00
0.121350 01	0.295930 00	0.127420 01	0.294520 00	0.133440 01	0.292640 00	0.139550 01	0.291030 00
0.145620 01	0.289320 00	0.151670 01	0.287120 00	0.157750 01	0.285460 00	0.163870 01	0.283910 00
0.169890 01	0.282570 00	0.175960 01	0.280970 00	0.182020 01	0.278840 00	0.188090 01	0.274310 00
0.194160 01	0.268960 00	0.200220 01	0.264170 00	0.206290 01	0.259360 00	0.212360 01	0.254540 00
0.218430 01	0.249070 00	0.224490 01	0.244330 00	0.230550 01	0.239590 00	0.236630 01	0.234100 00
0.242700 01	0.229020 00	0.248760 01	0.223520 00	0.254830 01	0.218040 00	0.260900 01	0.211830 00
0.266970 01	0.206430 00	0.273030 01	0.201050 00	0.279100 01	0.194880 00	0.285170 01	0.189640 00
0.291240 01	0.184480 00	0.297300 01	0.179380 00	0.303370 01	0.173230 00	0.309440 01	0.167710 00
0.315510 01	0.162270 00	0.321570 01	0.156040 00	0.327640 01	0.150750 00	0.333710 01	0.145540 00
0.339780 01	0.140360 00	0.345840 01	0.134400 00	0.351910 01	0.129310 00	0.357980 01	0.124260 00
0.364040 01	0.119070 00	0.370110 01	0.115070 00	0.376180 01	0.111150 00	0.382250 01	0.107290 00
0.388310 01	0.102710 00	0.394380 01	0.989750-01	0.400450 01	0.952870-01	0.406520 01	0.908890-01
0.412580 01	0.875170-01	0.418650 01	0.837760-01	0.424720 01	0.808630-01	0.430790 01	0.774930-01
0.436850 01	0.749530-01	0.442920 01	0.722340-01	0.448990 01	0.690030-01	0.455060 01	0.664640-01
0.461120 01	0.639420-01	0.467190 01	0.614620-01	0.473290 01	0.584150-01	0.479330 01	0.559430-01
0.485390 01	0.541250-01	0.491460 01	0.518390-01	0.497530 01	0.500810-01	0.503600 01	0.483480-01
0.509660 01	0.466200-01	0.515730 01	0.444600-01	0.521800 01	0.427770-01	0.527870 01	0.411000-01
0.533930 01	0.390210-01	0.540000 01	0.373700-01	0.546070 01	0.362010-01	0.552130 01	0.350250-01
0.558200 01	0.335040-01	0.564270 01	0.323580-01	0.570340 01	0.312120-01	0.576400 01	0.297590-01
0.582470 01	0.286350-01	0.588540 01	0.275130-01	0.594610 01	0.263910-01	0.600670 01	0.250810-01
0.606740 01	0.242890-01	0.612810 01	0.234760-01	0.618880 01	0.227030-01	0.624940 01	0.218020-01
0.631010 01	0.210170-01	0.637080 01	0.202510-01	0.643150 01	0.194460-01	0.649210 01	0.186600-01
0.655280 01	0.178740-01	0.661350 01	0.171410-01	0.667420 01	0.165390-01	0.673490 01	0.160370-01
0.679550 01	0.154850-01	0.685620 01	0.149350-01	0.691690 01	0.143810-01	0.697750 01	0.138290-01
0.703820 01	0.132770-01	0.709890 01	0.127250-01	0.715960 01	0.121730-01	0.722020 01	0.116780-01
0.728090 01	0.112990-01	0.734160 01	0.109190-01	0.740220 01	0.105400-01	0.746290 01	0.101600-01
0.752360 01	0.978090-02	0.758430 01	0.940140-02	0.764490 01	0.902190-02	0.770560 01	0.864240-02
0.776630 01	0.826290-02	0.782700 01	0.792940-02	0.788760 01	0.765360-02	0.794830 01	0.737770-02
0.800900 01	0.710180-02	0.806970 01	0.682600-02	0.813040 01	0.655010-02	0.819100 01	0.627420-02
0.825170 01	0.599840-02	0.831240 01	0.572250-02	0.837300 01	0.544660-02	0.843370 01	0.521700-02
0.849440 01	0.502430-02	0.855510 01	0.433170-02	0.861570 01	0.463910-02	0.867640 01	0.444640-02
0.873710 01	0.425380-02	0.879780 01	0.406110-02	0.885840 01	0.336850-02	0.891910 01	0.367580-02
0.897980 01	0.348320-02	0.904040 01	0.333340-02	0.910110 01	0.320600-02	0.916180 01	0.307820-02
0.922250 01	0.295040-02	0.928310 01	0.282260-02	0.934380 01	0.269480-02	0.940450 01	0.256700-02
0.946520 01	0.243920-02	0.952580 01	0.231140-02	0.958650 01	0.218360-02	0.964720 01	0.209010-02
0.970790 01	0.200650-02	0.976850 01	0.192280-02	0.982920 01	0.183920-02	0.988990 01	0.175550-02
0.995060 01	0.167190-02	0.100110 02	0.158820-02	0.100720 02	0.150460-02	0.101330 02	0.142090-02
0.101930 02	0.133730-02	0.102540 02	0.127780-02	0.103150 02	0.122550-02	0.103750 02	0.117150-02
0.104360 02	0.111730-02	0.104970 02	0.106310-02	0.105570 02	0.100900-02	0.106180 02	0.954810-03
0.106790 02	0.900640-03	0.107390 02	0.846470-03	0.108000 02	0.792300-03	0.108610 02	0.757720-03
0.109210 02	0.723150-03	0.109820 02	0.688570-03	0.110430 02	0.653990-03	0.111030 02	0.619410-03
0.111640 02	0.584830-03	0.112250 02	0.550250-03	0.112850 02	0.515670-03	0.113460 02	0.481090-03
0.114070 02	0.448150-03	0.114670 02	0.428350-03	0.115280 02	0.408510-03	0.115890 02	0.388690-03
0.116490 02	0.368870-03	0.117100 02	0.349050-03	0.117710 02	0.329230-03	0.118310 02	0.309410-03
0.118920 02	0.289590-03	0.119530 02	0.239770-03	0.120140 02	0.251730-03	0.120740 02	0.240240-03
0.121350 02	0.228690-03	0.121950 02	0.217150-03	0.122560 02	0.205600-03	0.123170 02	0.194050-03
0.123780 02	0.182510-03	0.124380 02	0.170960-03	0.124990 02	0.159420-03	0.125600 02	0.147870-03
0.126200 02	0.136870-03	0.126810 02	0.126980-03	0.127420 02	0.117090-03	0.128020 02	0.107190-03
0.128630 02	0.972960-04	0.129240 02	0.874010-04	0.129840 02	0.775060-04	0.130450 02	0.676120-04
0.131060 02	0.577170-04	0.131660 02	0.478220-04	0.132270 02	0.414480-04	0.132880 02	0.394750-04
0.133480 02	0.375010-04	0.134090 02	0.355270-04	0.134700 02	0.335540-04	0.135300 02	0.315800-04
0.135910 02	0.296070-04	0.136520 02	0.276330-04	0.137120 02	0.256600-04	0.137730 02	0.236860-04

0.13834D 02	0.22219D-04	0.13894D 02	0.21157D-04	0.13955D 02	0.20095D-04	0.14016D 02	0.19052D-04
0.14076D 02	0.17970D-04	0.14137D 02	0.16908D-04	0.14198D 02	0.15846D-04	0.14258D 02	0.14784D-04
0.14319D 02	0.13722D-04	0.14380D 02	0.12660D-04	0.14440D 02	0.11924D-04	0.14501D 02	0.11352D-04
0.14562D 02	0.10738D-04	0.14622D 02	0.10206D-04	0.14683D 02	0.96358D-05	0.14744D 02	0.90637D-05
0.14804D 02	0.84916D-05	0.14865D 02	0.79195D-05	0.14926D 02	0.73474D-05	0.14987D 02	0.67753D-05
0.15047D 02	0.64091D-05	0.15108D 02	0.61018D-05	0.15169D 02	0.57946D-05	0.15229D 02	0.54872D-05
0.15290D 02	0.51799D-05	0.15351D 02	0.48726D-05	0.15411D 02	0.45653D-05	0.15472D 02	0.42553D-05
0.15533D 02	0.39507D-05	0.15593D 02	0.36434D-05	0.15654D 02	0.34601D-05	0.15715D 02	0.32922D-05
0.15775D 02	0.31243D-05	0.15836D 02	0.29555D-05	0.15897D 02	0.27886D-05	0.15957D 02	0.26207D-05
0.16018D 02	0.24528D-05	0.16079D 02	0.22849D-05	0.16139D 02	0.21171D-05	0.16200D 02	0.19492D-05
0.16261D 02	0.18584D-05	0.16321D 02	0.17676D-05	0.16382D 02	0.16768D-05	0.16443D 02	0.15861D-05
0.16503D 02	0.14953D-05	0.16564D 02	0.14045D-05	0.16625D 02	0.13137D-05	0.16685D 02	0.12229D-05
0.16746D 02	0.11321D-05	0.16807D 02	0.10460D-05	0.16867D 02	0.99706D-06	0.16928D 02	0.94812D-06
0.16989D 02	0.89918D-06	0.17049D 02	0.85024D-06	0.17110D 02	0.80130D-06	0.17171D 02	0.75236D-06
0.17231D 02	0.70342D-06	0.17292D 02	0.65448D-06	0.17353D 02	0.60554D-06	0.17413D 02	0.55473D-06
0.17474D 02	0.49734D-06	0.17535D 02	0.43996D-06	0.17596D 02	0.38257D-06	0.17656D 02	0.32519D-06
0.17717D 02	0.26780D-06	0.17778D 02	0.21041D-06	0.17838D 02	0.15303D-06		

* PARTICULE INCIDENTE N SUR LE NOYAU Z= 39. A= 89.)

INCIDENT NEUTRON ON THE NUCLEUS Z = 39, A = 89

EI	INELASTIQUE	N-GAMMA	N-P	N-ALPHA
0.16000000D 02	0.17864751D 00	0.12919380D-02	0.29251736D-01	0.60641546D-03
0.18000000D 02	0.65809168D-01	0.13230199D-02	0.43602564D-01	0.91544471D-03

REACTIONS (N,XN) SUR Z= 39,A= 89, POUR X= 1 (n,xn) REACTIONS ON Z = 39, A = 89 FOR x = 1

****

	SIG(N,XN)	SIG(N,XNP)	SIG(N,XNALPHA)
SIG= 0.153500 01			
EI= 0.160000 02	0.17864751D 00	0.10775363D 00	0.42958560D-06
SIG= 0.153500 01			
EI= 0.180000 02	0.65809166D-01	0.74204597D-01	0.50824062D-05

```
REACTIONS (N,XN) SUR Z= 39,A=  89, POUR X= 2
**********************************************

*SEUIL DE LA REACTION  0.11596854D 02
                          SIG(N,XN)          SIG(N,XNP)          SIG(N,XNALPHA)
   SIG= 0.153500D 01
    EI= 0.160000D 02      0.12707779D 01     0.0                 0.0
   SIG= 0.153500D 01
    EI= 0.180000D 02      0.13528194D 01     0.0                 0.0
```

(n,xn) REACTIONS ON Z = 39, A = 89 FOR x = 2

```
REACTIONS (N,XN) SUR Z= 39.A=  89. POUR X= 3
*********************************************

*SEUIL DE LA REACTION  0.21078202D 02
                                SIG(N,XN)              SIG(N,XNP)
   SIG= 0.15350D 01
    EI= 0.16000D 02        0.0                    0.0
   SIG= 0.15350D 01
    EI= 0.18000D 02        0.0                    0.0
```

(n,xn) REACTIONS ON Z = 39, A = 89 FOR x = 3

```
   SIG(N,XNALPHA)
0.0
0.0
```

LA PARTICULE INCIDENTE EST UN NEUTRON
****

EMISSION DE PREEQUILIBRE CALCULEE
****

THE INCIDENT PARTICLE IS A NEUTRON

THE PREEQUILIBRIUM EMISSION IS CALCULATED

* PARTICULE INCIDENTE N SUR LE NOYAU Z= 39. A= 89.) NEUTRON INCIDENT ON THE TARGET Z = 39, A = 89

ENERGIE INCIDENTE	SIGMA-C(EI)
0.16000000D 02	0.15350000D 01
0.18000000D 02	0.15350000D 01

* LARGEURS NEUTRONS NEUTRON WIDTHS

NOYAU Z=39.A= 90.	E	GN	GN/(GN+GG+GP+GA)1
	0.40000000D 01	0.0	0.0
	0.42500000D 01	0.0	0.0
	0.45000000D 01	0.0	0.0
	0.47500000D 01	0.0	0.0
	0.50000000D 01	0.0	0.0
	0.52500000D 01	0.0	0.0
	0.55000000D 01	0.0	0.0
	0.57500000D 01	0.0	0.0
	0.60000000D 01	0.0	0.0
	0.62500000D 01	0.0	0.0
	0.65000000D 01	0.0	0.0
	0.67500000D 01	0.0	0.0
	0.70000000D 01	0.56448155D 00	0.87100939D 00
	0.72500000D 01	0.45869213D 01	0.97942527D 00
	0.75000000D 01	0.10758107D 02	0.99026727D 00
	0.77500000D 01	0.17491475D 02	0.99331635D 00
	0.80000000D 01	0.24246774D 02	0.99478604D 00
	0.82500000D 01	0.30935920D 02	0.99552552D 00
	0.85000000D 01	0.37892645D 02	0.99594688D 00
	0.87500000D 01	0.44982213D 02	0.99627501D 00
	0.90000000D 01	0.52013892D 02	0.99653225D 00
	0.92500000D 01	0.59137588D 02	0.99663730D 00
	0.95000000D 01	0.66541318D 02	0.99674040D 00
	0.97500000D 01	0.73673116D 02	0.99684123D 00
	0.10000000D 02	0.81154048D 02	0.99685448D 00
	0.10750000D 02	0.10529500D 03	0.99697108D 00
	0.11500000D 02	0.13450360D 03	0.99685982D 00
	0.12250000D 02	0.18564425D 03	0.99593514D 00
	0.13000000D 02	0.29830565D 03	0.99740679D 00
	0.13750000D 02	0.43741135D 03	0.99757405D 00
	0.14500000D 02	0.51367677D 03	0.99761808D 00
	0.15250000D 02	0.81631717D 03	0.99752219D 00
	0.16000000D 02	0.10502641D 04	0.99729075D 00
	0.16750000D 02	0.12691085D 04	0.99674057D 00
	0.17500000D 02	0.15299648D 04	0.99596903D 00
	0.18250000D 02	0.18570141D 04	0.99483370D 00
	0.19000000D 02	0.21605223D 04	0.99316053D 00
	0.19750000D 02	0.25592035D 04	0.99137602D 00
	0.20500000D 02	0.29403914D 04	0.98902948D 00
	0.21250000D 02	0.33986032D 04	0.98696696D 00
	0.22000000D 02	0.39454487D 04	0.98450656D 00
	0.22750000D 02	0.45313573D 04	0.98164173D 00
	0.23500000D 02	0.51872753D 04	0.97904697D 00
	0.24250000D 02	0.59392138D 04	0.97595202D 00
	0.25000000D 02	0.67977478D 04	0.97263222D 00

NUCLEUS

Z = 39, A = 90

NUCLEUS

Z = 39, A = 89

NOYAU	E	GN	GN/(GN+GG+GP+GA)
Z=39,A= 89.			
	0.400000000 01	0.0	0.0
	0.425000000 01	0.0	0.0
	0.450000000 01	0.0	0.0
	0.475000000 01	0.0	0.0
	0.500000000 01	0.0	0.0
	0.525000000 01	0.0	0.0
	0.550000000 01	0.0	0.0
	0.575000000 01	0.0	0.0
	0.600000000 01	0.0	0.0
	0.625000000 01	0.0	0.0
	0.650000000 01	0.0	0.0
	0.675000000 01	0.0	0.0
	0.700000000 01	0.0	0.0
	0.725000000 01	0.0	0.0
	0.750000000 01	0.0	0.0
	0.775000000 01	0.0	0.0
	0.800000000 01	0.0	0.0
	0.825000000 01	0.0	0.0
	0.850000000 01	0.0	0.0
	0.875000000 01	0.0	0.0
	0.900000000 01	0.0	0.0
	0.925000000 01	0.0	0.0
	0.950000000 01	0.0	0.0
	0.975000000 01	0.0	0.0
	0.100000000 02	0.0	0.0
	0.107500000 02	0.0	0.0
	0.115000000 02	0.167053770-01	0.331025960-01
	0.122500000 02	0.847794917D 01	0.912026820 00
	0.130000000 02	0.235265000 02	0.947261930 00
	0.137500000 02	0.427572390 02	0.955012020 00
	0.145000000 02	0.666623600 02	0.958044560 00
	0.152500000 02	0.965377410 02	0.958586030 00
	0.160000000 02	0.134993670 03	0.958371250 00
	0.167500000 02	0.187551590 03	0.957274920 00
	0.175000000 02	0.301017160 03	0.960345690 00
	0.182500000 02	0.491927750 03	0.962601710 00
	0.190000000 02	0.751370010 03	0.962286800 00

NUCLEUS

Z = 39, A = 88

NOYAU	E	GN	GN/(GN+GG+GP+GA)
Z=39,A= 88.			
	0.400000000 01	0.0	0.0
	0.425000000 01	0.0	0.0
	0.450000000 01	0.0	0.0
	0.475000000 01	0.0	0.0
	0.500000000 01	0.0	0.0
	0.525000000 01	0.0	0.0
	0.550000000 01	0.0	0.0
	0.575000000 01	0.0	0.0
	0.600000000 01	0.0	0.0
	0.625000000 01	0.0	0.0
	0.650000000 01	0.0	0.0

0.675000000 01	0.0	0.0	
0.700000000 01	0.0	0.0	
0.725000000 01	0.0	0.0	
0.750000000 01	0.0	0.0	
0.775000000 01	0.0	0.0	
0.800000000 01	0.0	0.0	
0.825000000 01	0.0	0.0	
0.850000000 01	0.0	0.0	
0.875000000 01	0.0	0.0	
0.900000000 01	0.0	0.0	
0.925000000 01	0.0	0.0	
0.950000000 01	0.300772130-01	0.995296750-01	
0.975000000 01	0.292079539 00	0.487601490 00	
0.100000000 02	0.750353679 00	0.678826050 00	
0.107500000 02	0.258504025 01	0.814669825 00	
0.115000000 02	0.498958869 01	0.838538960 00	

NUCLEUS

Z = 39, A = 87

NOYAU Z=39,A= 87.	F	GN	GN/(GN+GG+GP+GA)
	0.400000000 01	0.0	0.0
	0.425000000 01	0.0	0.0
	0.450000000 01	0.0	0.0
	0.475000000 01	0.0	0.0
	0.500000000 01	0.0	0.0
	0.525000000 01	0.0	0.0
	0.550000000 01	0.0	0.0
	0.575000000 01	0.0	0.0
	0.600000000 01	0.0	0.0
	0.625000000 01	0.0	0.0
	0.650000000 01	0.0	0.0
	0.675000000 01	0.0	0.0
	0.700000000 01	0.0	0.0
	0.725000000 01	0.0	0.0
	0.750000000 01	0.0	0.0
	0.775000000 01	0.0	0.0
	0.800000000 01	0.0	0.0
	0.825000000 01	0.0	0.0
	0.850000000 01	0.0	0.0
	0.875000000 01	0.0	0.0
	0.900000000 01	0.0	0.0
	0.925000000 01	0.0	0.0
	0.950000000 01	0.0	0.0
	0.975000000 01	0.0	0.0
	0.100000000 02	0.0	0.0

* LARGEURS GAMMAS

GAMMA WIDTHS

****

NOYAU	E	GG	GG/(GN+GG+GP+GA)
Z=39,A= 90.			
	0.40000000D 01	0.61055956D-01	0.10000000D 01
	0.42500000D 01	0.36172917D-01	0.10000000D 01
	0.45000000D 01	0.38208754D-01	0.10000000D 01
	0.47500000D 01	0.40552624D-01	0.10000000D 01
	0.50000000D 01	0.43162443D-01	0.10000000D 01
	0.52500000D 01	0.46335164D-01	0.10000000D 01
	0.55000000D 01	0.50275024D-01	0.10000000D 01
	0.57500000D 01	0.54459985D-01	0.10000000D 01
	0.60000000D 01	0.60152228D-01	0.10000000D 01
	0.62500000D 01	0.66895551D-01	0.10000000D 01
	0.65000000D 01	0.71208844D-01	0.10000000D 01
	0.67500000D 01	0.79455077D-01	0.10000000D 01
	0.70000000D 01	0.86557815D-01	0.12899061D 00
	0.72500000D 01	0.96357179D-01	0.20574728D-01
	0.75000000D 01	0.10573547D 00	0.97327338D-02
	0.77500000D 01	0.11769357D 00	0.66836531D-02
	0.80000000D 01	0.12708421D 00	0.52139553D-02
	0.82500000D 01	0.13910627D 00	0.44764794D-02
	0.85000000D 01	0.15416772D 00	0.40531188D-02
	0.87500000D 01	0.16814348D 00	0.37240753D-02
	0.90000000D 01	0.18074769D 00	0.34629421D-02
	0.92500000D 01	0.19884469D 00	0.33511012D-02
	0.95000000D 01	0.21555890D 00	0.32386493D-02
	0.97500000D 01	0.23078514D 00	0.31224488D-02
	0.10000000D 02	0.25167670D 00	0.30914667D-02
	0.10750000D 02	0.30783030D 00	0.29146484D-02
	0.11500000D 02	0.37463136D 00	0.27765424D-02
	0.12250000D 02	0.44766159D 00	0.24041200D-02
	0.13000000D 02	0.53210202D 00	0.17791221D-02
	0.13750000D 02	0.62377301D 00	0.14165770D-02
	0.14500000D 02	0.72813560D 00	0.11798415D-02
	0.15250000D 02	0.84149253D 00	0.10282859D-02
	0.16000000D 02	0.96519166D 00	0.93430108D-03
	0.16750000D 02	0.11052171D 01	0.86802249D-03
	0.17500000D 02	0.12575581D 01	0.81869258D-03
	0.18250000D 02	0.14236381D 01	0.77097025D-03
	0.19000000D 02	0.16036794D 01	0.73948640D-03
	0.19750000D 02	0.18086287D 01	0.70730445D-03
	0.20500000D 02	0.20271107D 01	0.68183855D-03
	0.21250000D 02	0.22659897D 01	0.65805179D-03
	0.22000000D 02	0.25244537D 01	0.62992614D-03
	0.22750000D 02	0.28045234D 01	0.60755245D-03
	0.23500000D 02	0.31077032D 01	0.58654826D-03
	0.24250000D 02	0.34342207D 01	0.56432295D-03
	0.25000000D 02	0.37857462D 01	0.54167040D-03

NUCLEUS

Z = 39, A = 90

NOYAU	E	GG	GG/(GN+GG+GP+GA)
Z=39,A= 89.			
	0.40000000D 01	0.69081140D-01	0.10000000D 01
	0.42500000D 01	0.74012431D-01	0.10000000D 01

NUCLEUS

Z = 39, A = 89

0.45000000D 01	0.78480507D-01	0.10000000D 01
0.47500000D 01	0.82489313D-01	0.10000000D 01
0.50000000D 01	0.86054588D-01	0.10000000D 01
0.52500000D 01	0.49690846D-01	0.10000000D 01
0.55000000D 01	0.51770538D-01	0.10000000D 01
0.57500000D 01	0.53953271D-01	0.10000000D 01
0.60000000D 01	0.56628204D-01	0.10000000D 01
0.62500000D 01	0.60127773D-01	0.10000000D 01
0.65000000D 01	0.63351645D-01	0.10000000D 01
0.67500000D 01	0.68595779D-01	0.10000000D 01
0.70000000D 01	0.74046225D-01	0.10000000D 01
0.72500000D 01	0.79138798D-01	0.10000000D 01
0.75000000D 01	0.86181034D-01	0.10000000D 01
0.77500000D 01	0.95676984D-01	0.10000000D 01
0.80000000D 01	0.10287990D 00	0.99999999D 00
0.82500000D 01	0.11239725D 00	0.99895082D 00
0.85000000D 01	0.11893254D 00	0.99404006D 00
0.87500000D 01	0.12774796D 00	0.93501374D 00
0.90000000D 01	0.13899258D 00	0.97260912D 00
0.92500000D 01	0.14879127D 00	0.95194335D 00
0.95000000D 01	0.16085514D 00	0.92928496D 00
0.97500000D 01	0.16961662D 00	0.90645666D 00
0.10000000D 02	0.18057936D 00	0.89273515D 00
0.10750000D 02	0.21531425D 00	0.70866600D 00
0.11500000D 02	0.25148834D 00	0.49833757D 00
0.12250000D 02	0.30977260D 00	0.33318143D-01
0.13000000D 02	0.37090029D 00	0.14932517D-01
0.13750000D 02	0.44273280D 00	0.93898551D-02
0.14500000D 02	0.52103759D 00	0.74881421D-02
0.15250000D 02	0.61104982D 00	0.69801075D-02
0.16000000D 02	0.70897736D 00	0.50332992D-02
0.16750000D 02	0.81572946D 00	0.41635336D-02
0.17500000D 02	0.93685541D 00	0.29952636D-02
0.18250000D 02	0.10706818D 01	0.20951047D-02
0.19000000D 02	0.12188465D 01	0.15609885D-02

NUCLEUS

Z = 39, A = 88

NOYAU
Z=39,A= 88.

E	GG	GG/(GN+GG+GP+GA)
0.40000000D 01	0.11435294D 00	0.10000000D 01
0.42500000D 01	0.12283749D 00	0.10000000D 01
0.45000000D 01	0.13057257D 00	0.10000000D 01
0.47500000D 01	0.13755544D 00	0.10000000D 01
0.50000000D 01	0.14380412D 00	0.10000000D 01
0.52500000D 01	0.14935174D 00	0.10000000D 01
0.55000000D 01	0.86417128D-01	0.10000000D 01
0.57500000D 01	0.89788224D-01	0.10000000D 01
0.60000000D 01	0.93643300D-01	0.10000000D 01
0.62500000D 01	0.98420091D-01	0.10000000D 01
0.65000000D 01	0.10305860D 00	0.10000000D 01
0.67500000D 01	0.11016797D 00	0.10000000D 01
0.70000000D 01	0.11779204D 00	0.10000000D 01
0.72500000D 01	0.12503317D 00	0.10000000D 01
0.75000000D 01	0.13721914D 00	0.99999999D 00
0.77500000D 01	0.14911986D 00	0.99993788D 00
0.80000000D 01	0.15970628D 00	0.99748201D 00
0.82500000D 01	0.17410754D 00	0.99114849D 00

0.850000000 01	0.186632250 00	0.930758580 00
0.875000000 01	0.203211020 00	0.965464240 00
0.900000000 01	0.217448370 00	0.943930130 00
0.925000000 01	0.228997410 00	0.918973050 00
0.950000000 01	0.249754200 00	0.810306770 00
0.975000000 01	0.276615470 00	0.450843260 00
0.100000000 02	0.297403110 00	0.269055100 00
0.107500000 02	0.374079050 00	0.117890200 00
0.115000000 02	0.455563240 00	0.762248120-01

NUCLEUS

Z = 39, A = 87

NOYAU Z=39,A= 87.	E	GG	GG/(GN+GG+GP+GA)
	0.400000000 01	0.686785380-01	0.100000000 01
	0.425000000 01	0.726495640-01	0.100000000 01
	0.450000000 01	0.765353860-01	0.100000000 01
	0.475000000 01	0.797506030-01	0.100000000 01
	0.500000000 01	0.325580790-01	0.100000000 01
	0.525000000 01	0.849654240-01	0.100000000 01
	0.550000000 01	0.870222710-01	0.100000000 01
	0.575000000 01	0.887682540-01	0.100000000 01
	0.600000000 01	0.902415770-01	0.100000000 01
	0.625000000 01	0.914780020-01	0.999999990 00
	0.650000000 01	0.925106090-01	0.999999970 00
	0.675000000 01	0.524819070-01	0.999999950 00
	0.700000000 01	0.548329260-01	0.991668190 00
	0.725000000 01	0.575609160-01	0.964986960 00
	0.750000000 01	0.612374680-01	0.922620390 00
	0.775000000 01	0.650156840-01	0.868309280 00
	0.800000000 01	0.710004060-01	0.795856520 00
	0.825000000 01	0.776003300-01	0.734255910 00
	0.850000000 01	0.838785970-01	0.683444760 00
	0.875000000 01	0.927389800-01	0.651169760 00
	0.900000000 01	0.100740700 00	0.575202570 00
	0.925000000 01	0.111385940 00	0.479653740 00
	0.950000000 01	0.121380200 00	0.393259130 00
	0.975000000 01	0.134767560 00	0.330554720 00
	0.100000000 02	0.145968140 00	0.292725770 00

* LARGEURS PROTONS ET ALPHAS
****

NOYAU	E	GP
Z=39,A= 90.		
	0.400000000 01	0.0
	0.425000000 01	0.0
	0.450000000 01	0.0
	0.475000000 01	0.0
	0.500000000 01	0.0
	0.525000000 01	0.0
	0.550000000 01	0.0
	0.575000000 01	0.0
	0.600000000 01	0.0
	0.625000000 01	0.0
	0.650000000 01	0.0
	0.675000000 01	0.0
	0.700000000 01	0.0
	0.725000000 01	0.0
	0.750000000 01	0.0
	0.775000000 01	0.376309030-11
	0.800000000 01	0.426912550-10
	0.825000000 01	0.144333680-09
	0.850000000 01	0.319001750-09
	0.875000000 01	0.412878340-04
	0.900000000 01	0.250898040-03
	0.925000000 01	0.688740820-03
	0.950000000 01	0.139423790-02
	0.975000000 01	0.268426220-02
	0.100000000 02	0.440032540-02
	0.107500000 02	0.120691550-01
	0.115000000 02	0.490646000-01
	0.122500000 02	0.114089780 00
	0.130000000 02	0.243433040 00
	0.137500000 02	0.444369060 00
	0.145000000 02	0.741133710 00
	0.152500000 02	0.118464520 01
	0.160000000 02	0.182147460 01
	0.167500000 02	0.390342070 01
	0.175000000 02	0.486900260 01
	0.182500000 02	0.796983780 01
	0.190000000 02	0.130569590 02
	0.197500000 02	0.199442400 02
	0.205000000 02	0.301532510 02
	0.212500000 02	0.419805830 02
	0.220000000 02	0.586474140 02
	0.227500000 02	0.805945150 02
	0.235000000 02	0.106092040 03
	0.242500000 02	0.140669200 03
	0.250000000 02	0.184747400 03

NOYAU	E	GP
Z=39,A= 89.		
	0.400000000 01	0.0
	0.425000000 01	0.0

PROTON AND ALPHA WIDTHS

NUCLEUS

Z = 39; A = 90

GP/(GN+GG+GP+GA)	GA/(GN+GG+GP+GA)
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	0.162535230-38
0.0	0.675065590-37
0.0	0.263290940-36
0.0	0.752121840-37
0.0	0.483823040-22
0.0	0.346946090-21
0.215700630-12	0.760722730-21
0.175151810-11	0.126017040-20
0.464469900-11	0.161747870-15
0.836665810-11	0.202278500-14
0.914495460-06	0.587601490-14
0.480694630-05	0.109973200-13
0.115954540-04	0.170395620-11
0.209476270-04	0.223590200-10
0.363172050-04	0.637667230-10
0.540574450-04	0.119027180-09
0.114275120-03	0.398286660-09
0.363637320-03	0.492848670-08
0.612707320-03	0.318605180-07
0.813936210-03	0.153783370-06
0.100863050-02	0.547441830-06
0.120090310-02	0.117769730-05
0.144761120-02	0.191191240-05
0.176317870-02	0.117853050-04
0.256277270-02	0.286308980-04
0.316394770-02	0.483312760-04
0.432689110-02	0.684428370-04
0.600668070-02	0.933044910-04
0.780042040-02	0.116255910-03
0.101372900-01	0.151387070-03
0.121915170-01	0.183668630-03
0.146347700-01	0.228748640-03
0.174594350-01	0.291287150-03
0.200238240-01	0.342655570-03
0.231152470-01	0.366408500-03
0.264339420-01	0.392164400-03

NUCLEUS

Z = 39, A = 89

GP/(GN+GG+GP+GA)	GA/(GN+GG+GP+GA)
0.0	0.0
0.0	0.0

0.450000000 01	0.0	0.0	0.0
0.475000000 01	0.0	0.0	0.0
0.500000000 01	0.0	0.0	0.0
0.525000000 01	0.0	0.0	0.0
0.550000000 01	0.0	0.0	0.0
0.575000000 01	0.0	0.0	0.0
0.600000000 01	0.0	0.0	0.0
0.625000000 01	0.0	0.0	0.0
0.650000000 01	0.0	0.0	0.0
0.675000000 01	0.0	0.0	0.0
0.700000000 01	0.0	0.0	0.0
0.725000000 01	0.10751269D-10	0.13623241D-09	0.0
0.750000000 01	0.12134633D-09	0.14103605D-08	0.0
0.775000000 01	0.40804244D-09	0.42647920D-08	0.0
0.800000000 01	0.39522966D-09	0.87016968D-08	0.73745479D-40
0.825000000 01	0.11804829D-03	0.10491755D-02	0.12519352D-37
0.850000000 01	0.71303058D-03	0.59599374D-02	0.62752941D-37
0.875000000 01	0.19435910D-02	0.14986258D-01	0.15508456D-36
0.900000000 01	0.39143415D-02	0.27390885D-01	0.22123451D-21
0.925000000 01	0.75113818D-02	0.48056649D-01	0.85453850D-20
0.950000000 01	0.12240463D-01	0.70715041D-01	0.31526618D-19
0.975000000 01	0.17508005D-01	0.93563341D-01	0.73466778D-19
0.100000000 02	0.21697612D-01	0.10726685D 00	0.35023347D-14
0.107500000 02	0.88516115D-01	0.29133400D 00	0.95794299D-12
0.115000000 02	0.23646087D 00	0.46855983D 00	0.47010106D-08
0.122500000 02	0.50815053D 00	0.54655054D-01	0.19327708D-03
0.130000000 02	0.93903058D 00	0.37805552D-01	0.42348342D-08
0.137500000 02	0.15713907D 01	0.35096081D-01	0.40250393D-07
0.145000000 02	0.23982688D 01	0.34466955D-01	0.34397157D-06
0.152500000 02	0.35509443D 01	0.35332856D-01	0.10240032D-05
0.160000000 02	0.51543241D 01	0.36592501D-01	0.29502383D-05
0.167500000 02	0.75539521D 01	0.38555858D-01	0.57069547D-05
0.175000000 02	0.11448814D 02	0.36640410D-01	0.18631967D-04
0.182500000 02	0.18015323D 02	0.35252292D-01	0.50390288D-04
0.190000000 02	0.28162396D 02	0.36067852D-01	0.84354892D-04

NUCLEUS

Z = 39, A = 88

NUYAU	E	GP	GP/(GN+GG+GP+GA)	GA/(GN+GG+GP+GA)
Z=39,A= 88.				
	0.400000000 01	0.0	0.0	0.0
	0.425000000 01	0.0	0.0	0.0
	0.450000000 01	0.0	0.0	0.0
	0.475000000 01	0.0	0.0	0.0
	0.500000000 01	0.0	0.0	0.0
	0.525000000 01	0.0	0.0	0.0
	0.550000000 01	0.0	0.0	0.0
	0.575000000 01	0.0	0.0	0.0
	0.600000000 01	0.0	0.0	0.0
	0.625000000 01	0.0	0.0	0.0
	0.650000000 01	0.0	0.0	0.0
	0.675000000 01	0.14390174D-12	0.13062031D-11	0.0
	0.700000000 01	0.53553480D-10	0.45303129D-09	0.13452212D-39
	0.725000000 01	0.29844190D-09	0.23869018D-08	0.41180618D-37
	0.750000000 01	0.81031401D-09	0.59052549D-08	0.20798222D-36
	0.775000000 01	0.92632515D-05	0.62115643D-04	0.51793250D-36
	0.800000000 01	0.40315333D-03	0.25179861D-02	0.48426236D-21
	0.825000000 01	0.15548785D-02	0.88515150D-02	0.27256997D-19

0.850000000D 01	0.366152290D-02	0.192414220D-01	0.105336750D-13
0.875000000D 01	0.726909120D-02	0.345357640D-01	0.243117940D-13
0.900000000D 01	0.129165300D-01	0.560698700D-01	0.531657580D-14
0.925000000D 01	0.201999750D-01	0.810269530D-01	0.425040420D-12
0.950000000D 01	0.277903710D-01	0.901635530D-01	0.132189800D-11
0.975000000D 01	0.369430990D-01	0.615552460D-01	0.174275340D-11
0.100000000D 02	0.576127770D-01	0.521208450D-01	0.361098150D-10
0.107500000D 02	0.215994720D 00	0.674399740D-01	0.582300990D-08
0.115000000D 02	0.507184100D 00	0.852362110D-01	0.152813820D-07

NUCLEUS

Z = 39, A = 87

NOYAU Z=39,A= 87.	E	GP	GP/(GN+GG+GP+GA)	GA/(GN+GG+GP+GA)
	0.400000000D 01	0.0	0.0	0.0
	0.425000000D 01	0.0	0.0	0.0
	0.450000000D 01	0.0	0.0	0.0
	0.475000000D 01	0.0	0.0	0.0
	0.500000000D 01	0.0	0.0	0.0
	0.525000000D 01	0.0	0.0	0.0
	0.550000000D 01	0.0	0.0	0.0
	0.575000000D 01	0.0	0.0	0.0
	0.600000000D 01	0.117286640D-09	0.130634510D-08	0.0
	0.625000000D 01	0.832692290D-09	0.910264400D-08	0.0
	0.650000000D 01	0.234962360D-08	0.253984230D-07	0.354160610D-39
	0.675000000D 01	0.259195820D-08	0.493876520D-07	0.107272050D-36
	0.700000000D 01	0.460695950D-03	0.833180990D-02	0.548607370D-36
	0.725000000D 01	0.208923310D-02	0.350130360D-01	0.135962050D-35
	0.750000000D 01	0.515594890D-02	0.773796070D-01	0.116657250D-20
	0.775000000D 01	0.986049820D-02	0.131690720D 00	0.623309250D-19
	0.800000000D 01	0.182121040D-01	0.204143460D 00	0.214759620D-18
	0.825000000D 01	0.280353440D-01	0.265744090D 00	0.450732330D-18
	0.850000000D 01	0.386305560D-01	0.316555240D 00	0.897611300D-14
	0.875000000D 01	0.496800730D-01	0.348830240D 00	0.657318630D-12
	0.900000000D 01	0.745938180D-01	0.424797430D 00	0.201656340D-11
	0.925000000D 01	0.121378040D 00	0.520346260D 00	0.381520880D-11
	0.950000000D 01	0.187580320D 00	0.606740870D 00	0.106686180D-09
	0.975000000D 01	0.272933650D 00	0.669445270D 00	0.436049260D-08
	0.100000000D 02	0.352083330D 00	0.707274220D 00	0.130502960D-07

* SECTIONS EFFICACES INVERSES

INVERSE CROSS SECTIONS

****

VALEURS DE LAGRANGE

EPS	SIGMA	EPS	SIGMA	EPS	SIGMA
0.900000000D 02					
0.0	0.0	0.100000000D-02	0.653400000D 01	0.500000000D-02	0.324600000D 01
0.100000000D-01	0.258600000D 01	0.500000000D-01	0.221300000D 01	0.100000000D 00	0.246200000D 01
0.200000000D 00	0.283200000D 01	0.300000000D 00	0.296600000D 01	0.400000000D 00	0.294600000D 01
0.500000000D 00	0.287500000D 01	0.600000000D 00	0.275330000D 01	0.800000000D 00	0.250000000D 01
0.100000000D 01	0.232500000D 01	0.200000000D 01	0.225800000D 01	0.300000000D 01	0.218500000D 01
0.400000000D 01	0.192400000D 01	0.500000000D 01	0.177000000D 01	0.600000000D 01	0.170700000D 01

0.700000000D 01	0.170000000D 01	0.300000000D 01	0.174400000D 01	0.900000000D 01	0.174200000D 01
0.100000000D 02	0.173500000D 01	0.120000000D 02	0.159700000D 01	0.140000000D 02	0.153874000D 01
0.160000000D 02	0.153500000D 01	0.180000000D 02	0.153500000D 01	0.200000000D 02	0.151800000D 01
0.890000000D 02					
0.0	0.0	0.100000000D-02	0.653400000D 01	0.500000000D-02	0.324600000D 01
0.100000000D-01	0.258400000D 01	0.500000000D-01	0.221300000D 01	0.100000000D 00	0.246200000D 01
0.200000000D 00	0.283400000D 01	0.300000000D 00	0.296600000D 01	0.400000000D 00	0.294600000D 01
0.500000000D 00	0.287500000D 01	0.600000000D 00	0.275330000D 01	0.800000000D 00	0.250000000D 01
0.100000000D 01	0.232500000D 01	0.200000000D 01	0.225800000D 01	0.300000000D 01	0.218500000D 01
0.400000000D 01	0.192400000D 01	0.500000000D 01	0.177000000D 01	0.600000000D 01	0.170700000D 01
0.700000000D 01	0.170000000D 01	0.800000000D 01	0.174400000D 01	0.900000000D 01	0.174200000D 01
0.100000000D 02	0.173500000D 01	0.120000000D 02	0.159700000D 01	0.140000000D 02	0.153874000D 01
0.160000000D 02	0.153500000D 01	0.180000000D 02	0.153500000D 01	0.200000000D 02	0.151800000D 01
0.880000000D 02					
0.0	0.0	0.100000000D-02	0.670498300D 01	0.500000000D-02	0.328600300D 01
0.100000000D-01	0.258400000D 01	0.200000000D-01	0.219900000D 01	0.300000000D-01	0.210000000D 01
0.400000000D-01	0.208200000D 01	0.500000000D-01	0.209700000D 01	0.600000000D-01	0.212700000D 01
0.700000000D-01	0.216400000D 01	0.800000000D-01	0.220400000D 01	0.900000000D-01	0.224500000D 01
0.100000000D 00	0.228700000D 01	0.200000000D 00	0.260800000D 01	0.300000000D 00	0.274200000D 01
0.400000000D 00	0.274500000D 01	0.500000000D 00	0.270000000D 01	0.600000000D 00	0.260500000D 01
0.700000000D 00	0.250200000D 01	0.800000000D 00	0.240100000D 01	0.900000000D 00	0.231300000D 01
0.100000000D 01	0.223900000D 01	0.150000000D 01	0.211400000D 01	0.200000000D 01	0.220400000D 01
0.250000000D 01	0.224500000D 01	0.300000000D 01	0.218500000D 01	0.400000000D 01	0.194000000D 01
0.500000000D 01	0.175800000D 01	0.600000000D 01	0.169900000D 01	0.700000000D 01	0.171200000D 01
0.800000000D 01	0.173500000D 01	0.900000000D 01	0.171300000D 01	0.100000000D 02	0.167900000D 01
0.120000000D 02	0.159500000D 01	0.140000000D 02	0.153800000D 01	0.160000000D 02	0.152200000D 01
0.180000000D 02	0.152300000D 01	0.200000000D 02	0.150900000D 01		
0.870000000D 02					
0.0	0.0	0.100000000D-02	0.670498300D 01	0.500000000D-02	0.328600300D 01
0.100000000D-01	0.258400000D 01	0.200000000D-01	0.219900000D 01	0.300000000D-01	0.210000000D 01
0.400000000D-01	0.208200000D 01	0.500000000D-01	0.209700000D 01	0.600000000D-01	0.212700000D 01
0.700000000D-01	0.216400000D 01	0.800000000D-01	0.220400000D 01	0.900000000D-01	0.224500000D 01
0.100000000D 00	0.228700000D 01	0.200000000D 00	0.260800000D 01	0.300000000D 00	0.274200000D 01
0.400000000D 00	0.274500000D 01	0.500000000D 00	0.270000000D 01	0.600000000D 00	0.260500000D 01
0.700000000D 00	0.250200000D 01	0.800000000D 00	0.240100000D 01	0.900000000D 00	0.231300000D 01
0.100000000D 01	0.223900000D 01	0.150000000D 01	0.211400000D 01	0.200000000D 01	0.220400000D 01
0.250000000D 01	0.224500000D 01	0.300000000D 01	0.218500000D 01	0.400000000D 01	0.194000000D 01
0.500000000D 01	0.175800000D 01	0.600000000D 01	0.169900000D 01	0.700000000D 01	0.171200000D 01
0.800000000D 01	0.173500000D 01	0.900000000D 01	0.171300000D 01	0.100000000D 02	0.167900000D 01
0.120000000D 02	0.159500000D 01	0.140000000D 02	0.153800000D 01	0.160000000D 02	0.152200000D 01
0.180000000D 02	0.152300000D 01	0.200000000D 02	0.150900000D 01		

```
* ENERGIES DE SEPARATION DES NEUTRONS-PROTONS-ALPHAS
***************************************************

     NOYAU        Z=39.A= 90.      S= 0.68660D 01      SP= 0.75671D 01

     NOYAU        Z=39.A= 89.      S= 0.11468D 02      SP= 0.70672D 01

     NOYAU        Z=39.A= 88.      S= 0.93760D 01      SP= 0.67120D 01

     NOYAU        Z=39.A= 87.      S= 0.11319D 02      SP= 0.57640D 01

* ENERGIES DE PAIRING
*********************

          P(  90.)= 0.0                        P(  89.)= 0.93000000D 00

          P(  88.)= 0.0                        P(  87.)= 0.14600000D 01

* PARAMETRES DE DENSITE DE NIVEAUX CALCULES
*******************************************
            FORME EXP(2.*SQRT(PA*U))/U**1.5
         ******************************

          PA(  90.)= 0.10060000D 02            PA(  89.)= 0.89160000D 01

          PA(  88.)= 0.95620000D 01            PA(  87.)= 0.96580000D 01

* ENERGIES DE TRANSITION**FORME EXP((E-E0)/T)**CALCULEES
*******************************************************

          E0(  90.)=-0.11570000D 01            E0(  89.)=-0.11810000D 00

          E0(  88.)=-0.15910000D 01            E0(  87.)= 0.61030003D 00

          E1(  90.)= 0.41670000D 01            E1(  89.)= 0.51150000D 01

          E1(  88.)= 0.53700000D 01            E1(  87.)= 0.67036000D 01

* TEMPERATURES DES NOYAUX CALCULEES
***********************************

          T(  90.)= 0.83770000D 00             T(  89.)= 0.90810000D 00

          T(  88.)= 0.92890000D 00             T(  87.)= 0.83237000D 00
```

NEUTRON-PROTON-ALPHA SEPARATION ENERGIES

SA= 0.61610D 01 GG/GT= 0.81700D-01

SA= 0.79500D 01 GG/GT= 0.24950D 00

SA= 0.69600D 01 GG/GT= 0.24184D 00

SA= 0.66600D 01 GG/GT= 0.24500D 00

PAIRING ENERGIES

CALCULATED LEVEL DENSITY PARAMETERS

TRANSITION ENERGIES

CALCULATED NUCLEAR TEMPERATURES

PARAMETRES DU PREEQUILIBRE PREEQUILIBRIUM PARAMETERS

IQX= 1 EKINI= 0.500D 01 AQ= -0.569D-03 BQ= 0.710D-01 ALPHA-I= 0.198D 00 BETA-I= 0.524D 00

SPECTRE NORMALISE DES NEUTRONS PRIMAIRES A L ENERGIE INCIDENTE E= 0.16000D 02

PRIMARY NEUTRONS NORMALIZED SPECTRUM

E	N(E)	E	N(E)	E	N(E)	E	N(E)
0.0	0.0	0.52741D 00	0.19417D 00	0.10546D 01	0.22037D 00	0.15822D 01	0.23371D 00
0.21096D 01	0.21962D 00	0.26370D 01	0.18996D 00	0.31644D 01	0.15592D 00	0.36919D 01	0.11783D 00
0.42193D 01	0.92745D-01	0.47467D 01	0.72393D-01	0.52741D 01	0.57230D-01	0.63015D 01	0.46238D-01
0.63289D 01	0.38014D-01	0.68563D 01	0.31973D-01	0.73837D 01	0.27513D-01	0.79111D 01	0.24290D-01
0.84385D 01	0.21428D-01	0.89659D 01	0.18967D-01	0.94933D 01	0.16951D-01	0.10021D 02	0.15200D-01
0.10548D 02	0.13527D-01	0.11076D 02	0.11603D-01	0.11603D 02	0.10198D-01	0.12130D 02	0.88829D-02
0.12658D 02	0.76277D-02	0.13185D 02	0.64192D-02	0.13713D 02	0.52942D-02	0.14240D 02	0.39757D-02
0.14767D 02	0.27138D-02	0.15295D 02	0.14021D-02	0.15822D 02	0.10852D-05		

SPECTRE NORMALISE DES NEUTRONS PRIMAIRES A L ENERGIE INCIDENTE E= 0.18000D 02 PRIMARY NEUTRONS NORMALIZED SPECTRUM

E	N(E)	E	N(E)	E	N(E)	E	N(E)
0.0	0.0	0.593330 00	0.172660 00	0.118670 01	0.192090 00	0.178000 01	0.206700 00
0.237330 01	0.188940 00	0.296670 01	0.162570 00	0.356000 01	0.127390 00	0.415330 01	0.990570-01
0.474670 01	0.777520-01	0.534000 01	0.619950-01	0.593330 01	0.506750-01	0.452670 01	0.422780-01
0.712000 01	0.361460-01	0.771330 01	0.318750-01	0.830670 01	0.281590-01	0.890000 01	0.249260-01
0.949330 01	0.223110-01	0.100370 02	0.200630-01	0.106800 02	0.179250-01	0.112730 02	0.156370-01
0.118670 02	0.138820-01	0.124000 02	0.123130-01	0.130530 02	0.108700-01	0.136470 02	0.953490-02
0.142400 02	0.824220-02	0.148330 02	0.696820-02	0.154270 02	0.570840-02	0.160200 02	0.437970-02
0.166130 02	0.299600-02	0.172070 02	0.154450-02	0.178000 02	0.266910-06		

PARAMETRES DU PREEQUILIBRE PREEQUILIBRIUM PARAMETERS

IQX= 1 EKINI= 0.500D 01 AW= -0.307D-03 BW= 0.710D-01 ALPHA-I= 0.198D 00 BETA-I= 0.524D 00

PARAMETRES DU PREEQUILIBRE

IQX= 1 EKINI= 0.5000 01 AW= -0.5099-03 BW= 0.7100-01 ALPHA-I= 0.1980 00 BETA-I= 0.5240 00

SPECTRE NORMALISE DES NEUTRONS DE LA REACTION I-2N A L ENERGIE INCIDENTE E= 0.160000 02

NORMALIZED NEUTRON SPECTRUM FROM (I,2n)

E	N(E)	E	N(E)	E	N(E)	E	N(E)
0.0	0.0	0.606740-01	0.178940-01	0.121350 00	0.357890-01	0.132020 00	0.536640-01
0.242700 00	0.719780-01	0.303370 00	0.894680-01	0.364040 00	0.107360 00	0.424720 00	0.125240 00
0.485390 00	0.143120 00	0.546070 00	0.161000 00	0.606740 00	0.177120 00	0.467420 00	0.179130 00
0.728090 00	0.181140 00	0.788760 00	0.133150 00	0.849440 00	0.185160 00	0.910110 00	0.187170 00
0.970790 00	0.189180 00	0.103150 01	0.191180 00	0.109210 01	0.193190 00	0.115290 01	0.195200 00
0.121350 01	0.197100 00	0.127420 01	0.198610 00	0.133480 01	0.200120 00	0.139550 01	0.201630 00
0.145620 01	0.203140 00	0.151690 01	0.204650 00	0.157750 01	0.206160 00	0.163820 01	0.207660 00
0.169890 01	0.209170 00	0.175960 01	0.210680 00	0.182020 01	0.211080 00	0.188090 01	0.209240 00
0.194160 01	0.207390 00	0.200220 01	0.205550 00	0.206290 01	0.203710 00	0.212340 01	0.201870 00
0.218430 01	0.200030 00	0.224490 01	0.198180 00	0.230560 01	0.196340 00	0.236630 01	0.194500 00
0.242700 01	0.192260 00	0.248760 01	0.189530 00	0.254830 01	0.186800 00	0.260900 01	0.184070 00
0.266970 01	0.181330 00	0.273030 01	0.178600 00	0.279100 01	0.175870 00	0.285170 01	0.173140 00
0.291240 01	0.170410 00	0.297300 01	0.167670 00	0.303370 01	0.164430 00	0.309440 01	0.160790 00
0.315510 01	0.157150 00	0.321570 01	0.155500 00	0.327640 01	0.147960 00	0.333710 01	0.146220 00
0.339780 01	0.142570 00	0.345840 01	0.138930 00	0.351910 01	0.135290 00	0.357980 01	0.131640 00
0.364040 01	0.128470 00	0.370110 01	0.125540 00	0.376180 01	0.122600 00	0.382250 01	0.119670 00
0.388310 01	0.116740 00	0.394380 01	0.113800 00	0.400450 01	0.110870 00	0.406520 01	0.107930 00
0.412580 01	0.105000 00	0.418650 01	0.102070 00	0.424720 01	0.996990-01	0.430790 01	0.974930-01
0.436850 01	0.952870-01	0.442920 01	0.930320-01	0.448990 01	0.908760-01	0.455060 01	0.836700-01
0.461120 01	0.864650-01	0.467190 01	0.842590-01	0.473260 01	0.820540-01	0.479330 01	0.798480-01
0.485390 01	0.781550-01	0.491460 01	0.765210-01	0.497530 01	0.748900-01	0.503600 01	0.732590-01
0.509660 01	0.716270-01	0.515730 01	0.699960-01	0.521800 01	0.683640-01	0.527870 01	0.667330-01
0.533930 01	0.651020-01	0.540000 01	0.634700-01	0.546070 01	0.622380-01	0.552130 01	0.611260-01
0.558200 01	0.599540-01	0.564270 01	0.587820-01	0.570340 01	0.576100-01	0.576400 01	0.564380-01
0.582470 01	0.552660-01	0.588540 01	0.540940-01	0.594610 01	0.529220-01	0.600680 01	0.517840-01
0.606740 01	0.509150-01	0.612810 01	0.500450-01	0.618880 01	0.491760-01	0.624940 01	0.483070-01
0.631010 01	0.474380-01	0.637080 01	0.465630-01	0.643150 01	0.456990-01	0.649210 01	0.448300-01
0.655280 01	0.439610-01	0.661350 01	0.431440-01	0.667420 01	0.425090-01	0.673480 01	0.413740-01
0.679550 01	0.412390-01	0.685620 01	0.406040-01	0.691690 01	0.399690-01	0.697750 01	0.393340-01
0.703820 01	0.386990-01	0.709890 01	0.380650-01	0.715960 01	0.374300-01	0.722020 01	0.363590-01
0.728090 01	0.364170-01	0.734160 01	0.359750-01	0.740220 01	0.355330-01	0.746290 01	0.350900-01
0.752360 01	0.346490-01	0.758430 01	0.342060-01	0.764490 01	0.337640-01	0.770560 01	0.333220-01
0.776630 01	0.328800-01	0.782700 01	0.324630-01	0.788760 01	0.320780-01	0.794830 01	0.316930-01
0.800900 01	0.313080-01	0.806970 01	0.309230-01	0.813030 01	0.305390-01	0.819100 01	0.301540-01
0.825170 01	0.297690-01	0.831240 01	0.293840-01	0.837300 01	0.289990-01	0.843370 01	0.286420-01
0.849440 01	0.283080-01	0.855510 01	0.279740-01	0.861570 01	0.276390-01	0.867640 01	0.273050-01
0.873710 01	0.269710-01	0.879780 01	0.266360-01	0.885840 01	0.263020-01	0.891910 01	0.259670-01
0.897980 01	0.256330-01	0.904040 01	0.253410-01	0.910110 01	0.250700-01	0.916180 01	0.247990-01
0.922250 01	0.245280-01	0.928310 01	0.242570-01	0.934380 01	0.239860-01	0.940450 01	0.237150-01
0.946520 01	0.234440-01	0.952580 01	0.231730-01	0.958650 01	0.229020-01	0.964720 01	0.226610-01
0.970790 01	0.224280-01	0.976850 01	0.221950-01	0.982920 01	0.219620-01	0.988990 01	0.217300-01
0.995060 01	0.214970-01	0.100110 02	0.212640-01	0.100720 02	0.210310-01	0.101330 02	0.207990-01
0.101950 02	0.205660-01	0.102540 02	0.203430-01	0.103150 02	0.201220-01	0.103750 02	0.199010-01
0.104360 02	0.196790-01	0.104970 02	0.194580-01	0.105570 02	0.192370-01	0.106180 02	0.190160-01
0.106790 02	0.187940-01	0.107390 02	0.185730-01	0.108000 02	0.183520-01	0.108610 02	0.181150-01
0.109210 02	0.178780-01	0.109820 02	0.176410-01	0.110430 02	0.174040-01	0.111030 02	0.171670-01
0.111640 02	0.169300-01	0.112250 02	0.166940-01	0.112850 02	0.164570-01	0.113460 02	0.162200-01
0.114070 02	0.159890-01	0.114670 02	0.158070-01	0.115280 02	0.156260-01	0.115890 02	0.154440-01
0.116490 02	0.152620-01	0.117100 02	0.150800-01	0.117710 02	0.148990-01	0.118310 02	0.147170-01
0.118920 02	0.145350-01	0.119530 02	0.143530-01	0.120130 02	0.141760-01	0.120740 02	0.140130-01
0.121350 02	0.138510-01	0.121960 02	0.136890-01	0.122560 02	0.135260-01	0.123170 02	0.133640-01
0.123780 02	0.132010-01	0.124380 02	0.130390-01	0.124990 02	0.128760-01	0.125600 02	0.127140-01
0.126200 02	0.125560-01	0.126810 02	0.124070-01	0.127420 02	0.122570-01	0.128030 02	0.121080-01
0.128630 02	0.119590-01	0.129240 02	0.118090-01	0.129840 02	0.116600-01	0.130450 02	0.115110-01
0.131060 02	0.113610-01	0.131660 02	0.112120-01	0.132270 02	0.110680-01	0.132880 02	0.109290-01
0.133480 02	0.107910-01	0.134090 02	0.106550-01	0.134700 02	0.105150-01	0.135300 02	0.103760-01
0.135910 02	0.102380-01	0.136520 02	0.101000-01	0.137120 02	0.996150-02	0.137730 02	0.982330-02

0.13834D 02	0.968750-02	0.13894D 02	0.955360-02	0.13955D 02	0.941980-02	0.14016D 02	0.923600-02
0.14076D 02	0.915210-02	0.14137D 02	0.901830-02	0.14198D 02	0.888450-02	0.14259D 02	0.875070-02
0.14319D 02	0.861680-02	0.14380D 02	0.848300-02	0.14440D 02	0.835050-02	0.14501D 02	0.821860-02
0.14562D 02	0.808670-02	0.14622D 02	0.795470-02	0.14683D 02	0.782280-02	0.14744D 02	0.769090-02
0.14804D 02	0.755900-02	0.14865D 02	0.742710-02	0.14926D 02	0.729520-02	0.14987D 02	0.716330-02
0.15047D 02	0.703260-02	0.15108D 02	0.690220-02	0.15169D 02	0.677170-02	0.15229D 02	0.664130-02
0.15290D 02	0.651090-02	0.15351D 02	0.638040-02	0.15411D 02	0.625000-02	0.15472D 02	0.611960-02
0.15533D 02	0.598910-02	0.15593D 02	0.585870-02	0.15654D 02	0.572190-02	0.15715D 02	0.558440-02
0.15775D 02	0.544680-02	0.15836D 02	0.530920-02				

NORMALIZED NEUTRON SPECTRUM FROM (I,2n)

SPECTRE NORMALISE DES NEUTRONS DE LA REACTION I-2N A L ENERGIE INCIDENTE E= 0.18000D 02

E	N(E)	E	N(E)	E	N(E)	E	N(E)
0.0	0.0	0.606740-01	0.252140-01	0.121350 00	0.504790-01	0.182020 00	0.754050-01
0.242700 00	0.965570-01	0.303370 00	0.120620 00	0.364040 00	0.141650 00	0.424720 00	0.167960 00
0.485390 00	0.178520 00	0.546070 00	0.195400 00	0.606740 00	0.209760 00	0.667420 00	0.211440 00
0.728090 00	0.212560 00	0.788760 00	0.213300 00	0.849440 00	0.213990 00	0.910110 00	0.214680 00
0.970790 00	0.215460 00	0.103150 01	0.216160 00	0.109210 01	0.216590 00	0.115280 01	0.217260 00
0.121350 01	0.217920 00	0.127420 01	0.218350 00	0.133480 01	0.218530 00	0.139550 01	0.218860 00
0.145620 01	0.219150 00	0.151690 01	0.219190 00	0.157750 01	0.219500 00	0.163820 01	0.219860 00
0.169890 01	0.220300 00	0.175960 01	0.220590 00	0.182020 01	0.220130 00	0.188090 01	0.217690 00
0.194160 01	0.214830 00	0.200220 01	0.212240 00	0.206290 01	0.209640 00	0.212360 01	0.207030 00
0.218430 01	0.204120 00	0.224490 01	0.201550 00	0.230560 01	0.178980 00	0.236630 01	0.195070 00
0.242700 01	0.193150 00	0.248760 01	0.189800 00	0.254830 01	0.186450 00	0.260900 01	0.182780 00
0.266970 01	0.179470 00	0.273030 01	0.176160 00	0.279100 01	0.172510 00	0.285170 01	0.169270 00
0.291240 01	0.166060 00	0.297300 01	0.162870 00	0.303370 01	0.158920 00	0.309440 01	0.155010 00
0.315510 01	0.151130 00	0.321570 01	0.146900 00	0.327640 01	0.143080 00	0.333710 01	0.139300 00
0.339780 01	0.135530 00	0.345840 01	0.131420 00	0.351910 01	0.127580 00	0.357980 01	0.123960 00
0.364040 01	0.120360 00	0.370110 01	0.117360 00	0.376180 01	0.114390 00	0.382250 01	0.111450 00
0.388310 01	0.108200 00	0.394380 01	0.105310 00	0.400450 01	0.102430 00	0.406520 01	0.992610-01
0.412580 01	0.964350-01	0.418650 01	0.935210-01	0.424720 01	0.913120-01	0.430790 01	0.882840-01
0.436850 01	0.867580-01	0.442920 01	0.846410-01	0.448990 01	0.822710-01	0.455060 01	0.801860-01
0.461120 01	0.781090-01	0.467190 01	0.760480-01	0.473260 01	0.737540-01	0.479330 01	0.717150-01
0.485390 01	0.701350-01	0.491460 01	0.684110-01	0.497530 01	0.659020-01	0.503600 01	0.654030-01
0.509660 01	0.639070-01	0.515730 01	0.622350-01	0.521800 01	0.607560-01	0.527870 01	0.592800-01
0.533930 01	0.576410-01	0.540000 01	0.561750-01	0.546070 01	0.551210-01	0.552130 01	0.540950-01
0.558200 01	0.528690-01	0.564270 01	0.518240-01	0.570340 01	0.507790-01	0.576400 01	0.476110-01
0.582470 01	0.485750-01	0.588540 01	0.475400-01	0.594610 01	0.465040-01	0.600670 01	0.454090-01
0.606740 01	0.446450-01	0.612810 01	0.438810-01	0.618880 01	0.431170-01	0.624940 01	0.423100-01
0.631010 01	0.415480-01	0.637080 01	0.407870-01	0.643150 01	0.400260-01	0.649210 01	0.392640-01
0.655280 01	0.385050-01	0.661350 01	0.377870-01	0.667420 01	0.372310-01	0.673480 01	0.366750-01
0.679550 01	0.361190-01	0.685620 01	0.355630-01	0.691690 01	0.350070-01	0.697750 01	0.344510-01
0.703820 01	0.338950-01	0.709890 01	0.333390-01	0.715960 01	0.327830-01	0.722020 01	0.322830-01
0.728090 01	0.318960-01	0.734160 01	0.315040-01	0.740220 01	0.311210-01	0.746290 01	0.307540-01
0.752360 01	0.303460-01	0.758430 01	0.299590-01	0.764490 01	0.295720-01	0.770560 01	0.291850-01
0.776630 01	0.287970-01	0.782700 01	0.284520-01	0.788760 01	0.280950-01	0.794830 01	0.277580-01
0.800900 01	0.274210-01	0.806970 01	0.270840-01	0.813030 01	0.267470-01	0.819100 01	0.264100-01
0.825170 01	0.260730-01	0.831240 01	0.257360-01	0.837300 01	0.253990-01	0.843370 01	0.250860-01
0.849440 01	0.247930-01	0.855510 01	0.245010-01	0.861570 01	0.242080-01	0.867640 01	0.239150-01
0.873710 01	0.236220-01	0.879780 01	0.233290-01	0.885840 01	0.230360-01	0.891910 01	0.227440-01
0.897980 01	0.224510-01	0.904040 01	0.221950-01	0.910110 01	0.219570-01	0.916180 01	0.217200-01
0.922250 01	0.214830-01	0.928310 01	0.212450-01	0.934380 01	0.210080-01	0.940450 01	0.207710-01
0.946520 01	0.205330-01	0.952590 01	0.202950-01	0.958650 01	0.200590-01	0.964720 01	0.198470-01
0.970790 01	0.196430-01	0.976850 01	0.194400-01	0.982920 01	0.192360-01	0.988990 01	0.190320-01
0.995060 01	0.188280-01	0.100110 02	0.186240-01	0.100720 02	0.184200-01	0.101330 02	0.182160-01
0.101930 02	0.180130-01	0.102540 02	0.178160-01	0.103150 02	0.176240-01	0.103750 02	0.174300-01
0.104360 02	0.172360-01	0.104970 02	0.170420-01	0.105570 02	0.168430-01	0.106180 02	0.166550-01
0.106790 02	0.164610-01	0.107390 02	0.162670-01	0.108000 02	0.160730-01	0.108610 02	0.158660-01
0.109210 02	0.156580-01	0.109820 02	0.154510-01	0.110430 02	0.152430-01	0.111030 02	0.150350-01
0.111640 02	0.148280-01	0.112250 02	0.146210-01	0.112850 02	0.144140-01	0.113460 02	0.142060-01
0.114070 02	0.140040-01	0.114670 02	0.138450-01	0.115280 02	0.136260-01	0.115890 02	0.135260-01
0.116490 02	0.133670-01	0.117100 02	0.132080-01	0.117710 02	0.130490-01	0.118310 02	0.128900-01
0.118920 02	0.127300-01	0.119530 02	0.125710-01	0.120150 02	0.124160-01	0.120740 02	0.122740-01
0.121350 02	0.121310-01	0.121960 02	0.119890-01	0.122560 02	0.118470-01	0.123170 02	0.117050-01
0.123780 02	0.115620-01	0.124380 02	0.114200-01	0.124990 02	0.112780-01	0.125600 02	0.111350-01
0.126200 02	0.109970-01	0.126810 02	0.108660-01	0.127420 02	0.107350-01	0.128020 02	0.106050-01
0.128630 02	0.104740-01	0.129240 02	0.103430-01	0.129840 02	0.102120-01	0.130450 02	0.100820-01
0.131060 02	0.995070-02	0.131660 02	0.981990-02	0.132270 02	0.969350-02	0.132880 02	0.957240-02
0.133480 02	0.945130-02	0.134090 02	0.933020-02	0.134700 02	0.920910-02	0.135300 02	0.908800-02
0.135910 02	0.896690-02	0.136520 02	0.884580-02	0.137120 02	0.872480-02	0.137730 02	0.860370-02

0.13834D 02	0.848470-02	0.13894D 02	0.83475D-02	0.13955D 02	0.82503D-02	0.14016D 02	0.81331D-02
0.14076D 02	0.80159D-02	0.14137D 02	0.78987D-02	0.14198D 02	0.778140-02	0.14258D 02	0.76642D-02
0.14319D 02	0.75470D-02	0.14380D 02	0.74298D-02	0.14440D 02	0.73137D-02	0.14501D 02	0.71982D-02
0.14562D 02	0.70827D-02	0.14622D 02	0.69671D-02	0.14683D 02	0.68516D-02	0.14744D 02	0.67361D-02
0.14804D 02	0.66206D-02	0.14865D 02	0.65050D-02	0.14926D 02	0.63895D-02	0.14937D 02	0.62740D-02
0.15047D 02	0.61595D-02	0.15108D 02	0.60452D-02	0.15169D 02	0.59310D-02	0.15229D 02	0.53167D-02
0.15290D 02	0.57025D-02	0.15351D 02	0.55883D-02	0.15411D 02	0.54740D-02	0.15472D 02	0.53598D-02
0.15533D 02	0.52456D-02	0.15593D 02	0.51315D-02	0.15654D 02	0.50115D-02	0.15715D 02	0.43910D-02
0.15775D 02	0.47706D-02	0.15836D 02	0.46501D-02	0.15897D 02	0.45296D-02	0.15957D 02	0.44091D-02
0.16018D 02	0.42886D-02	0.16079D 02	0.41682D-02	0.16139D 02	0.40477D-02	0.15200D 02	0.39272D-02
0.16261D 02	0.38017D-02	0.16321D 02	0.36763D-02	0.16382D 02	0.35508D-02	0.16443D 02	0.34253D-02
0.16503D 02	0.32999D-02	0.16564D 02	0.31744D-02	0.16625D 02	0.30489D-02	0.16685D 02	0.29233D-02
0.16746D 02	0.27980D-02	0.16807D 02	0.26719D-02	0.16867D 02	0.25403D-02	0.16928D 02	0.24086D-02
0.16989D 02	0.22770D-02	0.17049D 02	0.21454D-02	0.17110D 02	0.20138D-02	0.17171D 02	0.18821D-02
0.17231D 02	0.17505D-02	0.17292D 02	0.16189D-02	0.17353D 02	0.14873D-02	0.17413D 02	0.13538D-02
0.17474D 02	0.12137D-02	0.17535D 02	0.10737D-02	0.17596D 02	0.93365D-03	0.17656D 02	0.79360D-03
0.17717D 02	0.65356D-03	0.17778D 02	0.51351D-03	0.17838D 02	0.37346D-03		

NEUTRON INCIDENT ON Z = 39, A = 89

```
* PARTICULE INCIDENTE N SUR LE NOYAU Z= 39. A=  89.)
*****************************************************
```

EI	INELASTIQUE	N-GAMMA	N-P	N-ALPHA
0.160000000 02	0.360678260 00	0.940173230-03	0.265536950-01	0.441297020-03
0.180000000 02	0.265945850 00	0.800126920-03	0.364103540-01	0.557040750-03

REACTIONS (N,XN) SUR Z= 39,A= 89, POUR X= 1 (n,xn) REACTIONS ON Z = 39, A = 89 FOR x = 1

****

	SIG(N,XN)	SIG(N,XNP)	SIG(N,XNALPHA)
SIG= 0.15350D 01			
EI= 0.16000D 02	0.36007626D 00	0.11256011D 00	0.34748142D-06
SIG= 0.15350D 01			
EI= 0.18000D 02	0.26394585D 00	0.82748657D-01	0.36447306D-05

(n,xn) REACTIONS ON Z = 39, A = 89 FOR x = 2

```
REACTIONS (N,XN) SUR Z= 39.A=  89. POUR X= 2
*********************************************

*SEUIL DE LA REACTION  0.11596854D 02
                          SIG(N,XN)          SIG(N,XNP)          SIG(N,XNALPHA)
   SIG= 0.15350D 01
    EI= 0.16000D 02       0.10332267D 01     0.0                 0.0
   SIG= 0.15350D 01
    EI= 0.18000D 02       0.11305285D 01     0.0                 0.0
```

```
REACTIONS (N,XN) SUR Z= 39,A=  89, POUR X= 3
*********************************************

*SEUIL DE LA REACTION  0.21078202D 02
                                SIG(N,XN)              SIG(N,XNP)
   SIG= 0.15350D 01
    EI= 0.16000D 02             0.0                    0.0
   SIG= 0.15350D 01
    EI= 0.18000D 02             0.0                    0.0
```

(n,xn) REACTIONS ON Z = 39, A = 89 FOR x = 3

```
   SIG(N,XNALPHA)
0.0
0.0
```

* PARTICULE INCIDENTE N SUR LE NOYAU Z= 39. A= 89.0
****

EI	N-2N	N-3N
0.160000000D 02	0.105562010 01	0.0
0.180000000D 02	0.115052830 01	0.0

NEUTRON INCIDENT ON Z = 39, A = 89

EX	N-2N EX
0.160000000D 02	0.105000000 01
0.180000000D 02	0.105000000 01