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*****************************************
******************************* BIB-SECT
*
* REFERENCE   (C,68WASH,2,885,6803) PR
*               CONTRIBUTION.
*             (P,EANDC(E)-89,37,6802)
*             (J,NP/A,118,9,6805) FINA
*               MEASUREMENTS.
* AUTHOR      (H.K.VONACH,F.G.VONACH,
* TITLE       -PRECISION MEASUREMENTS
*               OF (N,P),(N,A) AND (N,2
*               13.5 - 14.7 MEV NEUTRON
* INSTITUTE   (2GERMUN)
* N-SOURCE    (D-T  ) BOMBARDMENT OF A
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*               WERE USED BY VARYING TH
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* METHOD      (ACTIV) GAMMA PULSES EX
*               TA-180M WHERE BETAS WER
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* SAMPLE      .NATURAL MATERIALS. ME
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*               CORRESPONDING TO 30
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*               IN THE TOTAL ERROR.
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*               TA-180M.
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* HISTORY     (781017C) PDJ. RECOMPILE
*             (790219E)
*             (800115A) REACTION STRIN
*               022 AND 023 CHANGED.
*             (800115E)
*             (800424A) DATA HEADINGS
*             (800603E)
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** END BIB-SECTION ******************
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* REACTION    (23-V-51(N,A)21-SC-48,,S
*               RATIO TO THE 14.7 MEV C
* STATUS      .PUBLISHED TABLE.
* HISTORY     (781018C) PDJ.
*             (790219E)
*             (800424A) DATA HEADINGS
*             (800603F)
*
** END BIB-SECTION ******************

** NO COMMON-SECTION ****************
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	EN MEV	EN-ERR MEV	DATA ARB-UNI
1	13.6	0.075	0.820
2	13.7	0.075	0.836
3	13.8	0.075	0.852
4	13.9	0.075	0.867
5	14.0	0.075	0.885
6	14.1	0.075	0.902

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** END DATA-SECTION ****************
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NNDEN/42

NEUTRON NUCLEAR DATA EVALUATION NEWSLETTER

NEA DATA BANK
BANQUES DE DONNÉES DE L'AEN

January 1989

NNDEN/42

NEUTRON NUCLEAR DATA EVALUATION NEWSLETTER

NEA DATA BANK
BANQUES DE DONNÉES DE L'AEN

January 1989

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NEUTRON NUCLEAR DATA EVALUATION NEWSLETTER

NNDEN/42

The Newsletter reports:

1. Evaluation work on particular nuclides.
2. Development of codes for nuclear model calculations, and other codes needed for nuclear data work.
3. Publications relevant to the neutron data field.

Contributions have been received from:

		Page
AUSTRALIA	Australian Nuclear Science and Technology Organisation	8
BRAZIL	Centro Técnico Aeroespacial, Instituto de Estudos Avançados	9
BULGARIA	Institute for Nuclear Research and Nuclear Energy	10
CHINA	Institute of Atomic Energy, Beijing	11
	Nankai University, Tianjin	12
	Fudan University, Shanghai	13
FRANCE	CEN, Bruyères-le-Châtel	15
	CEN, Cadarache	16
INDIA	Bhabha Atomic Research Centre, Trombay	18
	Indira Gandhi Centre, Kalpakkam	20
ITALY	ENEA, Bologna	22
JAPAN	Nuclear Data Center, JAERI	28
NETHERLANDS	ECN, Petten	30
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	ORNL, Oak Ridge	43
EFF (European Fusion File)	ECN, Petten	49
GEEL	CBNM	50
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The next issue of NNDEN has been scheduled for October 1989 and contributors are asked to send in their reports by 15th September 1989.

NEW EVALUATIONS A) COMPLETED
B) IN PROGRESS
C) PLANNED IN THE NEAR FUTURE

NUCLIDE	DATA TYPE	ENERGY RANGE	PAGE A	PAGE B	PAGE C
H-1	(n,n)	14.7MeV	50		
He-3	(n,tot),(n,n)	10^{-5}eV-20MeV		29	
He-4	(n,tot),(n,n) (n,p)(n,d)	10^{-5}eV-20MeV		29	
Li-7	(n,n't)	2.5 10^{-2}eV-20MeV		11	
Li-7	(n,n't)	10^{-5}eV-20MeV	41		
Be	many			38	
Be-9	many				9
B-11			29		
Mg-24	(n,p)		37		
Al	many			11	
Al-27	(n,α)		37		
Al-27	(n,α)	14.7MeV	50		
Al-27	(n,p)	14.7MeV	50		
S	many			11	
S-32	(n,p)	TR-5MeV	45		
S-32	(n,p)	14.7MeV	50		
P	many			11	
Ar-40	res.(n,γ)		45		
V	many		37		
Cr	many	10^{-5}eV-20MeV	29		
Cr-isot	many	10^{-5}eV-20MeV	44		
Cr-50	many	10^{-5}eV-20MeV	46		
Cr-50	(n,γ)	1KeV-20MeV	24		
Cr-52	(n,γ)	1KeV-20MeV	24		
Cr-52	many	10^{-5}eV-20MeV	46		
Cr-52	trans				48
Cr-52	(n,n)(n,n')	15Kev-1MeV	46		
Cr-53	(n,γ)	1KeV-20MeV	24		
Cr-53	many	10^{-5}eV-20MeV	46		
Cr-54	(n,γ)	1KeV-20MeV	24		
Cr-54	many	10^{-5}eV-20MeV	46		
Mn	many			11	

NUCLIDE	DATA TYPE	ENERGY RANGE	PAGE A	PAGE B	PAGE C
Fe	many	10^{-5}eV-20MeV	29		
Fe-isot	many	10^{-5}eV-20MeV	44		
Fe-Nat	many	High		9	
Fe-54	(n,γ),(n,2nγ) (n,pγ)(n,αγ)	1MeV-20MeV		25	
Fe-54	(n,n)(n,n')	15KeV-1MeV	46		
Fe-54	many	10^{-5}eV-20MeV	46		
Fe-56	(n,γ),(n,2nγ) (n,pγ)(n,αγ)	1MeV-20MeV		25	
Fe-56	(n,p)		11		
Fe-56	many	10^{-5}eV-20MeV	46		
Fe-56	many	High		9	
Fe-56	(n,p)	14.7MeV	50		
Fe-57	trans				48
Fe-57	(n,γ),(n,2nγ) (n,pγ)(n,αγ)	1MeV-20MeV		25	
Fe-57	many	10^{-5}eV-20MeV	46		
Fe-58	(n,γ),(n,2nγ) (n,pγ)(n,αγ)	1MeV-20MeV		25	
Fe-58	many	10^{-5}eV-20MeV	46		
Co	many		37		
Co	many		11		
Co-59	(n,α)	14.7MeV	50		
Ni	many	10^{-5}eV-20MeV	30		
Ni	many	10^{-5}eV-20MeV	29		
Ni-isot	many	10^{-5}eV-20MeV	44		
Ni-58	many			18	
Ni-58	many	5KeV-813KeV	45		
Ni-58	many	10^{-5}eV-20MeV	45		
Ni-60	many			18	
Ni-60	many	10^{-5}eV-20MeV	45		
Ni-61	many	10^{-5}eV-20MeV	45		
Ni-62	many	10^{-5}eV-20MeV	45		
Ni-64	many	10^{-5}eV-20MeV	45		
Cu-isot	many	10^{-5}eV-20MeV	44		
Cu-63	(n,2n)	14.7MeV	50		
Cu-63	trans				48
Cu-63	many	10^{-5}eV-20MeV	46		
Cu-65	(n,2n)	14.7MeV	50		
Cu-65	many	10^{-5}eV-20MeV	46		
Cu-65	trans				48
Zr	many			37	

NUCLIDE	DATA TYPE	ENERGY RANGE	PAGE A	PAGE B	PAGE C
Nb	$\frac{d\sigma(n,n)}{dAdE}$	5MeV-8MeV	36		
Nb-93	(n,n')			38	
Nb-93	many	1MeV-20MeV	32		
Nb-93	(n,2n)	14.7MeV	50		
Ru-102	many	10^{-5}eV-20MeV		30	
Sn	$\frac{d\sigma(n,n)}{dAdE}$	5MeV-20MeV	36		
Ho	$\frac{d\sigma(n,n)}{dAdE}$	5MeV-20MeV	36		
Hf-isot	γ-multipl.	25-2		10	
Ta	$\frac{d\sigma(n,n)}{dAdE}$	5MeV-8MeV	36		
W	many			11	
W-184	neutr. emiss.	11.5MeV-20MeV	33		
Au-197	(n,2n)	14.7MeV	50		
Pb	many			11	
Pb-Nat	many	10^{-5}eV-20MeV	44		
Pb-204	(n,n)(n,n')	15KeV-1MeV	46		
Pb-206	many	10^{-5}eV-20MeV	46		
Pb-207	many	10^{-5}eV-20MeV	46		
Pb-208	many	10^{-5}eV-20MeV	46		
Bi	$\frac{d\sigma(n,n)}{dAdE}$	5MeV-8MeV	36		
Bi	many			37	
Th-230	(N,F)	14.74MeV	37		
Th-232	(N,F)	14.74MeV	37		
Th-232	many	High		9	
Th-232	res. par.			9	
Th-232	neutr. spectrum	2MeV	8		
Th-232	neutr. cst.	unresolv. res.		10	
U-232	many	fast	28		
U-233	(N,F)	14.74MeV	37		
U-233	(N,F)		29		
U-233	many	High		9	
U-233	neutr. spectrum		8		
U-234	(N,F)	14.74MeV	37		
U-235	νp	resolv. range	16		
U-235	νp				16

NUCLIDE	DATA TYPE	ENERGY RANGE	PAGE A	PAGE B	PAGE C
U-235	(N,F)	14.7MeV	50		
U-235	neutr. spectrum		8		
U-235	many	High		9	
U-235	many	reson. region	44		
U-235	(n,n')		40		
U-235	many		51		
U-236	(N,F)	14.74MeV	37		
U-238	(N,F)	14.7MeV	50		
U-238	many	14.74MeV	37		
U-238	neut. cst.	unresolv. res.		10	
U-238	neutr. spectrum	2MeV	8		
U-238	many	High		9	
U-238	many			31	
U-238	many			38	
U-238	many	1MeV-100 MeV		42	
Np-237	(N,F)	14.74MeV	37		
Np-237	many	1MeV-100MeV		42	
Pu	many	resolv. res. region	44		
Pu-238	neutr. spectrum			8	
Pu-239	νp	resolv. range	16		
Pu-239	many		51		
Pu-239	many	Up to 20MeV		42	
Pu-239	(N,F)	14.74MeV	37		
Pu-239	neutr. spectrum	Thermal	8		
Pu-239	many	Unresolv. Range		16	
Pu-239	many	30KeV-20MeV		16	
Pu-239	νp	res. range		16	
Pu-240	many		51		
Pu-240	neutr. spectrum			8	
Pu-241	many		51		
Pu-241	νp	resolv. range	16		
Pu-241	neutr. cst.	0.1-30KeV	10		
Pu-242	(N,F)	14.74MeV	37		
Pu-242	neutr. spectrum			8	
Pu-242	many		51		
Am-241	many	10^{-5}eV-20MeV		29	
Am-241	many	10^{-5}eV-20MeV	51		
Am-242M	many	10^{-5}eV-20MeV		29	
Am-243	many	10^{-5}eV-20MeV		29	
Bk-249	many	10^{-5}eV-20MeV	51		
Bk-250	many		28		
Cf-249			51		
Cf-252	neutr. spectrum	spontan.	8		
Cf-252	νp spect.	spontan.	39		
Cf-252	many		28		

AUSTRALIAN NUCLEAR SCIENCE & TECHNOLOGY ORGANISATION, LUCAS HEIGHTS (formerly Australian Atomic Energy Commission)

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Australia

Names: R.L. Walsh and G. Chircu*
(*University of New South Wales)

Activity: Calculation of fission neutron spectra using Madland-Nix Model.

Results:
- Fission spectra and spectrum integrals calculated for
  . 2 MeV fission of ^{232}Th, ^{238}U
  . thermal fission of ^{233}U, ^{235}U, ^{239}Pu
  . spontaneous fission of ^{252}Cf
- Effect of fragment spin incorporated (neutron anisotropy parameter b = 0.1)
- Effect of neutrons from accelerating fragments incorporated
- Tabulated data available

Publications:

R.L. Walsh
"Calculation of fission spectrum integrals for the energy region 15-20 MeV of fission neutron spectra", NEANDC(E) 241/L, INDC(FR)70/L

R.L. Walsh and G. Chircu
"Calculation of fission neutron spectra with incorporation of fragment spin and pre-acceleration neutron emission", Proc. Int. Conf. Neutron Physics, Kiev, U.S.S.R, 21-25 September 1987.

R.L. Walsh and G. Chircu
"Calculation of fission neutron spectrum with incorporation of pre-acceleration neutron emission", Proc. IAEA Consultants Meeting on 'Physics of Neutron Emission in Fission', Mito, Japan, 24-27 May 1988.

Work in Progress: Calculation of fission neutron spectra for nuclei of importance to nuclear safeguards: ^{240}Pu, ^{238}Pu and ^{242}Pu.

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Contact: B.V. Carlson

Work in Progress:

- Evaluation of continuum cross sections of ^{56}Fe, ^{nat}Fe, ^{232}Th, ^{233}U, ^{235}U and ^{238}U.
- Evaluation of ^{232}Th resonance parameters.
- Modification, testing and intercomparison of optical model, DWBA and coupled channel codes to permit the use of a dispersion term in the potential.
- Modification of the level density fitting code, AMLETO, and statistical model codes to permit use of the Ignatyuk level density.
- Modification of the code ECIS88 to permit the adjustment of energy-dependent optical model parameters.
- Comparison of combinatorial calculations of exciton model transition rates and accessible final state densities with iterative calculations.
- Calculations of one-step continuum DWBA strength functions and double differential cross sections for various structural elements.
- Development of three-body model of deuteron induced reactions.

Work Planned:

- Evaluation of ^{9}Be
- Development of two-step continuum DWBA code
- Study of parameter systematics of the Ignatyuk level density
- Modeling of fission product distributions

INSTITUTE FOR NUCLEAR RESEARCH AND NUCLEAR ENERGY
BULGARIAN ACADEMY OF SCIENCES

Names: N.Janeva, S.Toshkov, A.Mateeva, N.Tchikov.
Address: Institute for Nuclear Research and Nuclear Energy, Blvd. Lenin 72, 1784 Sofia, Bulgaria

Recent publications:

1. Method for Resonance Cross Sections Averaging in R-matrix Theory.
   A.G.Visotzkii, A.A.Lukyanov, N.Savova, N.Janeva in Neutron Physics, Moskow - 1988 (Kiev Conf. of Neutron Physics, 1987) v.2, p.116.
2. Evaluation of Pu-241 Neutron Constants for Energy Region 0,1-30 KeV.
   N.Kojumdjieva, N.Savova, S.Toshkov, N.Janeva in Neutron Physics, Moskow - 1988 (Kiev Conf. of Neutron Physics, 1987) v.1, p.409.
3. Energy Averaged Resonance Neutron Cross Sections.
   N.B.Janeva, A.A.Lukyanov. Int. Conf. in Nuclear Data for Science and Technology, Mito, Japan, 1988.
4. Gamma Ray Multiplicity Spectrometry at the IRT-2000 Research Reactor.
   G.Georgiev, I.Sirakov, N.Tchikov, N.Janeva. Symp. on Multipurpose Research Reactors, Grenoble, 1987, p.67.

Work recently completed or in progress

1. Fluctuation Factors of Average Cross Sections in R-matrix Theory.
   N.Kojumdjieva, N.Savova, N.Janeva, A.A.Lukyanov, submitted to Bulgarian Journal of Physics.
2. Gamma Ray Multiplicity of Hafnium Isotopes at Thermal Point.
   G.Georgiev, T.Madjarsky, N.Stantcheva, N.Tchikov, N.Janeva.
3. Evaluation of Th-232 and U-238 Neutron Constants in the Unresolved Resonance Region.
   N.Janeva, Alami N.Mohamed, A.Lukyanov, S.Toshkov.
4. Facility for Measurement of Neutron Cross Sections and Gamma Ray Multiplicity.
   G.Georgiev, S.Toshkov, N.Janeva at al.

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People's Republic of China
Telex: 222373 IAE CN
Telephone: 868221 ext. 830

Name of person to be contacted: Zhou Delin

Work in progress:

1. In 1988 the following neutron nuclear data were evaluated in ENDF-4 format for CENDL-2:

   Pb (by Zhou Yimin)
   W (by Ma Gonggui)
   Co (by Qi Huiquan)
   Mn (by Liu Yunchang)
   Al (by Liu Jicai)
   S (by Si Yi)
   P (by Zhou Yongyi)

2. Systematic study of averaged neutron capture cross sections around 25 keV. (to be published) by Zhao Zhixiang, Zhou Delin and Cai Dunjiu.

3. Systematics study of excitation function of neutron capture reaction. (to be published) by Zhao Zhixiang et al..

4. Evaluation of ^{7}Li(n,n't) cross section in the energy region from E_{th}-20MeV. (to be published). By Yu Baosheng and Cai Dunjiu.

5. Evaluation of ^{56}Fe(n,p) cross section (to be published). By Yuan Hanrong.

Name of Institute: Nankai University, China

Address: Department of Physics, Nankai University, Tianjin, The People's Republic of China.

Name of person to be contacted: Yu Zi-qiang

(I) Work in progress:

We are researching the MUP-III program. On the basis of MUP-II [1] program we make the following improvements:

(i) The generalized exciton model [2] is used instead of the exciton model used in MUP-II. MUP-II can be used to calculate the double differential cross section of the secondary particles.

(ii) MUP-III includes the direct reaction mechanism. There are two subprograms to calculate the differential cross sections and integral cross sections of the direct inelastic reaction as well as the integral cross sections of the direct (n,p) reaction respectively based on the DWBA method. In the preequilibrium emission, we introduce the cluster formation factors for the complex particles which have a similar meaning to the pickup mechanism in the theory of direct reaction. These factors account for the contribution of the direct (n,x) reaction, where x can be α, d, 3H and 3He.

(iii) For the convenience of the users, MUP-III will consist of several subprograms. They may be used singularly or jointly.

(iv) MUP-III includes an auxilary program which is similar to the AUJP-I [3] and can search automatically for the optimum set of the neutron optical model parameters for the deformed nuclei.

(v) MUP-III will output the neutron nuclear data including the cross sections, angular distributions, secondary particle spectra and double differential cross sections according to the ENDF/B-VI format.

II. Work recently completed

We have researched a program to calculate the direct (n,p) reaction cross sections based on the DWBA method with the zero-range approximation.

Reference:

[1] IAEA0907/01, No. 1-February 1986, NEWS FROM THE NEA DATA BANK.
[2] Sun Ziyang et al., Z. Phys. A305, 61 (1982).
[3] IAEA0906/01, No. 1-February 1986. NEWS FROM THE NEA DATA BANK.

Name of institute: Fudan University, Shanghai, China

Address: Nuclear Science Department, Fudan University, Shanghai, China

Name of person to be contacted: Prof. Yu-Kun Ho

Work in progress:

1. We study the mechanisms of radiative neutron capture reaction, which is classified according to the hierarchy of quasiparticle number in the excited configurations, namely channel capture for one quasiparticle configuration (including potential capture, valence capture, interference between potential and valence capture, and capture in the compound elastic scattering channel); doorway mechanism for three quasiparticle configuration (including semidirect capture, capture in the compound inelastic scattering channel, annihination of three quasiparticle configuration, and inelastic valence capture); statistical process for five and more quasiparticle configurations. Furthermore, we are developing a unified model for (n,γ) reaction based upon the multi-step approach.

2. A model code, named GRS, has been developed to calculate neutron induced photon production data, including photon production cross section, photon multiplicities, photon energy spectra as well as reaction and level cross sections. In this code, the full energy range is divided into two regions. In the higher energy region, specifically MeV region of neutron incident energy and resonance region where average over incident energy is meaningful, the code provides resonance-averaged data. Four processes are taken into account for the (n,γ) cross sections, namely compound nucleus process, radiative capture in the compound elastic and inelastic scattering channels, direct-semidirect capture. At lower energy region from thermal to the first resonance, three processes are taken into account to calculate the (n,γ) cross section at a sharp incident energy, i.e. compound nucleus cascade de-excitation, potential and valence capture, as well as their interference effect.

3. We are computing systematically neutron induced photon production data with emphasis on the structure materials used in fusion reactor.

Work recently completed and planned:

1. In the past five years, studing the (n,γ) reaction mechanism is one of our mainly interesting subjects, and more than twenty papers or reports have been published in this field. In addition, a quite wide international cooperation with IAEA and some chief international laboratories and personal contact have been set up.

2. The model code GRS has been completed, which now can provide photon production data from thermal to 3MeV. A extension to higher energy region (e.g. 20MeV) is now actively undertaken.

3. We have already provided some of the calculated photon production data to Chinese Nuclear Data Centre (mostly in the energy range from thermal to 3MeV). A comprehansive program now is planning to calculate systematically the data for the structure material used in fusion reactor.

Some portion of the recent publications and reports:

1. Mechanisms of neutron radiative capture reaction, Talk at IAEA Advisory Group Meeting on Nuclear Theory for Fast Neutron Nuclear Data Evaluation, Beijing, 1987, to be published in IAEA-TECDOC Series.
2. The unified model of neutron capture reaction, Proc. of Intern. Conf. on Nucl. Data, Mito, Japan (1988)
3. Strong Non-statistical effect in 2p size resonance region, Accepted by Physical Review C (1988)
4. Neutron effective charge in E1 and E2 radiative transitions, Invited talk at 6th Capture Gamma-ray Symposium, Leuven (1987); J. of Phys. G: Nucl. Phys. 14 s(1988)207
4. New development in resonance photoneutron spectroscopy, J. of Phys. G: Nucl. Phys. 14 s(1988)257
5. Direct E2 neutron capture in light nuclei, Phys. Rev. c34(1986)408
6. An extremely strong E1 transition in C-14, Chinese Phys. Lett. (in English) 4(1987)7
7. Nonstatistical effect in radiative neutron capture at 3s giant resonance region, Chinese Physics(AIP, in English) 8(1988)455
8. E2 and E1 radiative neutron valence width and effective charge in C-13, Chinese Physics(AIP, in English) 8(1988)738
9. GRS - A statistical and nonstatistical model code for calculations of gamma ray spectrum, Proc. of Intern. Conf. on Nucl. Data, Santa Fe(1985)1053
10. Channel wave function and channel radiative capture cross section, Proc. of 5th Capture Gamma-ray Spectroscopy, Knoxville(1984)362
11. Resonance averaged channel radiative neutron capture cross section, Nucl. Phys. A406(1983)1
12. An interference effect in channel radiative neutron capture process, Nucl. Phys. A406(1983)17

This work is supported by IAEA Agency under research contract 5234/RB, and National Science Fundation (China) under contract No. 1870106.

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I. RECENT PUBLICATIONS AND REPORTS

- Optical Model Description of the Neutron Interaction with ^{116}Sn and ^{120}Sn over a wide energy range.
  P.P. GUSS et al. [1] Submitted to Phys. Rev. C.

- Neutron ^{90}Zr mean field from a dispersive optical model analysis.
  J.P. DELAROCHE et al. [2] accepted for publication in Phys. Rev. C.

- Impact of the Dispersion Relation on the Analyzing Power for neutron elastic scattering from ^{40}Ca.
  J.P. DELAROCHE et al. [1] Phys. Lett./B203 (1988) 4.

- Energy Dependence of the deformed optical potential for neutron scattering from ^{56,57}Fe and ^{58,60}Ni up to 80 MeV.
  R.S. PEDRONI et al. [1] accepted for publication in Phys. Rev. C.

- Dispersion relation approach to the Coulomb correction term of proton nucleus optical model potential.
  J.P. DELAROCHE et al. [1] Phys. Lett./B210 (1988) 26.

II. WORK RECENTLY COMPLETED

- Ground State band deformations of ^{155,156,157,158,160}Gd from neutron scattering measurements and Hartree-Fock-Bogolyubov calculations.
  J.P. DELAROCHE et al., to be submitted to Phys. Rev. C.

III. WORK IN PROGRESS

- Analyse des spectres de neutrons issus de la réaction d^{7}Li.
  O. BERSILLON.

- Effet Doppler sur les sections efficaces différentielles.
  O. BERSILLON.

IV. WORK PLANNED FOR THE FUTURE

- Energy dependence of the deformed optical potential and dispersion relation correction for n + ^{184}W below 26 MeV.
  J.P. DELAROCHE et al. (2).

REFERENCES

[1] In collaboration with Duke University, Durham, USA.
[2] In collaboration with Ohio University, Athens, USA.

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I - RECENT PUBLICATIONS AND REPORTS

- Analysis of the experimental results from ν prompt of ^{239}Pu, ^{241}Pu, ^{235}U in the resolved range - Complementarity of the integral and microscopic information (Contributed paper Mito).
  E. FORT, J. FREHAUT, H. TELLIER, P. LONG

- Nuclear data for the U.Pu fuel cycle evaluation (Review paper Mito conference).
  E. FORT

- A matrix analysis of ^{239}Pu cross sections in the energy range thermal to 1 KeV.
  H. DERRIEN, G. DE SAUSSURE

- A matrix analysis of ^{241}Pu cross sections in the energy range thermal to 300 eV.
  H. DERRIEN, G. DE SAUSSURE

II - WORK IN PROGRESS

- Evaluation of the cross sections of ^{239}Pu in the unresolved range.
  H. DERRIEN

- Reevaluation of the cross sections of ^{239}Pu between 30 KeV and 20 MeV.
  E. FORT

- Reevaluation of ν_p of 239Pu in the resolved range.
  E. FORT

- Evaluation of the prompt gamma energy released in fission of ^{239}Pu.
  E. FORT

III - WORK PLANNED FOR THE FUTURE

- Collaboration with ORNL for complementary work on ^{239}Pu, ^{241}Pu and ^{235}U in the resolved and unresolved range.
  H. DERRIEN, G. DE SAUSSURE

- νp evaluation for ^{235}U.
  E. FORT, J. FREHAUT, H. TELLIER

- Establishment of covariance for ^{239}Pu.
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RECENT PUBLICATIONS:

1. S.B. Garg and S.S. Kapoor; Determination of Level Density Parameters by Analysing (n,2n) and (n,3n) Cross-sections with Geometry Dependent Hybrid Model, Proc. Nucl. Phys. Symp. 30B, 260 (1987), BARC, Bombay, India.

2. S.B. Garg; Binary and Tertiary Neutron Reaction Cross-sections of Chromium and Iron, Paper Presented at the 2nd CRP Meeting held at IAEA Headquarters Vienna during Feb. 1988 on 'Methods for the Calculation of Fast Neutron Nuclear Data for Structural Elements'.

3. K. Subba Rao, S.B. Garg, G.V. Acharya and M. Srinivasan; Systematics of Criticality Data of Special Actinide Nuclides Deduced Through Trombay Criticality Formula, Paper communicated for publication to Nuclear Science and engineering (1988).

4. S.B. Garg; A Comparative Study of Nuclear Models With Special Reference to Neutron Cross-sections of Structural Elements, Paper communicated for presentation at the Nuclear Physics Symp. to be held at BARC, Bombay (1988)

5. S.B. Garg; A Geometry Dependent Hybrid Model Based Study of Angle-Energy Correlated Double Differential Cross-sections, Paper Communicated for presentation at the Nuclear Physics Symp. to be held at BARC, Bombay (1988).

WORK RECENTLY COMPLETED

1. Generation of 35 Group Neutron Cross-sections of Special Actinide Elements Pa-231, Pa-233, Np-237, Am-241, Am-243, Cm-243, Cm-244, Cm-245, Cm-247, Cf-249 and Cf-251.

2. Criticality Studies of Fast Multiplying Assemblies Fuelled with Pa-231, Pa-233, U-234, Np-237, Pu-238, Am-241, Am-242m, Cm-243, Cm-244, Cm-245, Cm-247, Cf-249, Cf-251.

WORK IN PROGRESS

Investigation of Neutron Reaction Cross-sections of Ni-58 and Ni-60 Based on pre-equilibrium and statistical models.

COMPUTER CODES

1. GRAPE Code package has been commissioned and tested. This package utilizes unified exciton model of the pre-equilibrium decay and solves the time integrated master equation to yield multiparticle reaction cross-sections, energy spectra and the angle-energy correlated double differential cross-sections of the emitted particles.

2. A new version of ALICE-85 code based on Hybrid and Geometry Dependent Hybrid models has been tested. This version includes gamma-ray competition in the equilibrium and pre-equilibrium decay schemes of the reactions.

3. SMUG and LAPHNGAS Codes have been tested. These codes generate multi-group photon interaction cross-sections and gamma-ray production cross-sections from the basic photon and neutron cross-section libraries.

4. For processing, generation and utilization of nuclear cross-sections several codes including MINX, SPHINX, BINX, LINX, CINX, XLACS-IIA, NJOY and I2D have been commissioned and tested.

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NAMES: S. Ganesan, M. M. Ramanadhan, V. Gopalakrishnan and K. Devan.

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RECENT PUBLICATIONS AND REPORTS:

1. S. Ganesan, "Development of Indian Cross Section Data Files for Th-232 and U-233 and Integral Validation Studies".

Invited talk presented at the international conference on Nuclear Data for Science and Technoogy held in Mito, Japan, during 30-5-88 to 3-6-88.

2. S.Ganesan, "Statistical Theory of Fluctuations in Neutron-Nucleus Cross Sections and Use of 'ABAREX' the Optical Statistical Model Code". Lecture Notes distributed at the ICTP Workshop on Applied Nuclear Theory and Nuclear Model Calculations for Nuclear Technology Applications held at Trieste, Italy during Feb. 15 - March 18, 1988. To be published as a contribution in a book by the publisher: World Scientific Publishing Co. Pvt. Ltd., Singapore, as Proceedings of the ICTP Workshop on Applied Nuclear Theory and Nuclear Model Calculations for Nuclear Technology Applications.

3. V. Gopalakrishnan and S.Ganesan, "REX2-87, A Code for Calculating Self-Shielded Multigroup Neutron Cross Sections and Self-Shielding Factors from Preprocessed ENDF/B Basic Data File", Note: IGCAR/NDS-18, August 1988;

4. V. Gopalakrishnan and S.Ganesan, "REX1-87, A Code for multigrouping Neutron Cross Sections from preprocessed ENDF/B Basic Data File", Internal Note: IGCAR/NDS-13. Mainframe versions of REX1 and REX2 have been made available to Nuclear Energy Agency Data Bank. PC versions of REX1 and REX2 have also been created.

5. S. Ganesan, "Input Specifications and Sample Problems for ABAREX, the Optical-statistical Model Code", IGCAR/NDS-19 (September, 1988). PC version has been created and made available to Nuclear Energy Agency Data Bank.

6. M. M. Ramanadhan, V. Gopalakrishnan and S. Ganesan, "REX3-88, A code for Calculation of Self-shielding Factors in the Unresolved Resonance Region" (Note under preparation)

7. S. Ganesan, V. Gopalakrishnan, M.M.Ramanadhan and D.E. Cullen (1987) "Verification of the Accuracy of Doppler Broadened Self-shielded Multigroup Cross Sections for Fast Power Reactor Applications", Annals of Nuclear Energy, Vol 15, No.3, pp 113 - 140 (1988). This paper deals with round 2 of IAEA Nuclear Data Processing Code Verification Project.

8. S. Ganesan, "A Report on the International Conference on Nuclear data for Science and Technology held in Mito, Japan during May 30-June 3, 1988", Submitted for favour of publication to PHYSICS NEWS.

WORK IN PROGRESS:

- Continuing nuclear data services for requests in India.
- Continuing evaluations and review for nuclear data for thorium cycle
- Code verification in the unresolved resonance region.
- Improvements in ABAREX code.

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I. PUBLICATIONS

[1] A. Mengoni, F. Fabbri, G. Maino, "Gamma-ray production cross sections following ^{52}Cr(n,n'gamma) reaction", Institute of Physics Series 88, 664 (1988)

[2] F. Fabbri, G. Maino, A. Mengoni, E. Menapace, "Gamma-ray production data and related nuclear structure calculations", to be published in Proceed. of Int. Conf. on Nuclear Data for Science and Technology, Mito (Japan), May 30-June 3, 1988.

[3] M. Pescarini, Transport calculations for the PCA-REPLICA shielding benchmark: A validation of JEF-1 data and SN codes for the prediction of LWR's pressure vessel neutron damage, ENEA-TIB Bologna, 7th International Conference on Radiation Shielding, Papers Submitted Volume, I, Bournemouth, England, September 12-16, 1988.

2. WORK RECENTLY COMPLETED

1) Activities on model for data calculations

Calculation of photon production cross sections and spectra, arising from neutron capture and inelastic scattering reactions, have been performed for some structural materials in the incident neutron energy range 1.0MeV<En<20MeV, of interest for applied purposes. The role played by nuclear structure effect has been investigated as far as both discrete and continuum levels and relevant electromagnetic transition are concerned. In particular a semiempirical formula for level densities has been developed, which reproduces the theoretical parity distribution of excited levels, estimated within a Nilsson plus BCS model. Inclusion of parity effects in level density formalism has a great influence on statistical calculations of neutron capture cross sections, of the order of 30-50% over the whole energy range up to several MeV and increases the average radiative widths, which are roughly proportional to the total neutron capture rate. Moreover, we have performed some calculations of photon production cross sections and spectra in order to verify if the present approach to nuclear level densities is reliable and able to reproduce the experimental data.

Relevant results for 56Fe(n,x gamma) reactions are in satisfactory agreement with the available measurements. Finally the Hauser-Fechbach statistical model has been applied to the analysis of discrete gamma-ray production cross section. Calculations performed for the ^{52}Cr(n,n'gamma) reaction at the incident neutron energy

En=14.2 MeV compare successfully with the relevant experimental information.

2) Evaluation

- Cr isotopes of natural chromium, i.e. ^{50}Cr(4.35%), ^{52}Cr(83.79%), ^{53}Cr(9.50%) and ^{54}Cr(2.36%). In this work, neutron cross sections and gamma-ray spectra are evaluated for each isotope in the incident neutron energy range 1KeV-20MeV.

Photon production cross sections have been calculated and spectra following neutron-induced reaction in the energy range from 1KeV to 8MeV by means of a modified version of the PENELOPE code. In this energy interval, the main sources of emitted gamma-rays are neutron radiative capture and inelastic scattering processes. The latter is predominant in the MeV region, just above the threshold energy. Gamma-ray cascades originating from (n,gamma) and (n,n'gamma) reactions are then described in the framework of statistical model, allowing up to seven successive decays, sufficient in the considered energy range.

For ease of application, for instance in reactor physics and shielding calculations, the evaluated neutron reactor physics and photon production data have been set up in a standard way, according to ENDF/B rules and formats. To this end, an original chain of codes has been developed, both for single isotopes and the natural element.

- Fe isotopes within the framework of a general study of neutron-induced reactions of structural materials, an evaluation of neutron cross sections for stable iron isotopes, namely ^{54}Fe(5.8%), ^{56}Fe(91.72%), ^{57}Fe(2.2%) and ^{58}Fe(0.28%), has been partially performed. This evaluation covers the incident neutron energy range from 1 MeV, when the continuum region starts above the resonance domain, up to 20MeV. In particular, the gamma-ray production cross sections and spectra are calculated for the following processes: radiative capture, inelastic scattering, (n,2n gamma), (n,p gamma) and (n,alpha gamma).

  The evaluation makes use of techniques and computing codes already tested in the calculations performed for chromium isotopes. In particular neutron induced reaction on ^{56}Fe have been considered and standard optical model and GR parameters for this mass region have been used. The level density parameters have been determined on the basis of experimental information and microscopic BCS calculations. In this way calculations of neutron cross sections and photon production data for ^{56}Fe have been completed in the incident neutron energy range 1MeV<En<20MeV. Neutron inelastic scattering (n,2n), (n,p), and (n,alpha) cross sections, so obtained, compare well with the corresponding experimental data.

3) Activities in nuclear data management processing validation

a) Extensive computations have been carried out in order to assess the validity of the new Cr isotope evaluations, with particular emphasis put on the gamma-ray production files and the comparison both with existing evaluations and experimental data. The NJOY-87 recently implemented on the new machine (IBM 3090/300E) has been extensively used for this purpose.

b) The MERGE code for combining together the probability table produced by CALENDF and group data generated by THEMIS has been designed and implemented. The code is in use: among its features, it accepts both the THEMIS and NJOY GENDF format.

c) The problem of self-shielding of the inelastic cross section of structural materials has been investigated. The results confirm the opportunity of considering the self-shielding of the inelastic cross sections of ^{56}Fe.

(Activities b) and c) have been carried out in cooperation with U. Broccoli and P. Peerani - ENEA Reactor Department.)

d) The multigroup neutron library VITAMIN-J has been validated together with additional nuclides processed in the same 171 group structure through the NJOY/THEMIS system. All data used are processed from the JEF-1 nuclear data file.

For this purpose discrete ordinates transport calculations (using ANISM 1D and DOT 3.5E 2D SN codes) have been performed for the (H2O/Fe) PCA-Replica shielding benchmark, officially sponsored by OECD/NEACRP (the Nuclear Energy Agency Committee on Reactor Physics) for nuclear data validation. The experimental facility of the PCA-Replica Winfrith benchmark duplicates exactly the 12.13 configuration of the Oak Ridge PCA (Pool Critical Assembly) experiment. These zero power experiments reproduce the ex-core configuration of a typical PWR. The study of the neutron attenuation in water and iron layers together with connected spectral variations are the main goals of these experiments.

The comparison with experimental activities has been presented at the 7th International Conference on Radiation Shielding (Bournemouth, UK, September 1988) [3].

A neutron damage calculation in iron was performed as well, using DPA cross sections obtained from the JEF-1 iron file.

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Work Resently Completed and Publications

1) T. Nakagawa: "Evaluation of Neutron Nuclear Data for ^{252}Cf and ^{250}Bk", JAERI-M 88-004 (1988).

2) (Ed.) T. Nakagawa and A. Zukeran: "Proceedings of the 1987 Seminar on Nuclear Data", JAERI-M 88-065 (1988).

3) S. Chiba and K. Shibata: "Revision and Status of the Neutron Nuclear Data of ^{6}Li and ^{7}Li", JAERI-M 88-164 (1988).

4) T. Ohsawa and T. Shibata: "Nuclear Data Evaluation for ^{232}U in the Fast Neutron Region", Annual Report of Kinki University Atomic Energy Research Institute, vol.25 (1988).

5) H. Kitazawa, Y. Harima and T. Fukahori: "Evaluation of Neutron Cross Sections of the sd-Shell Nuclei ^{27}Al and ^{28,29,30}Si", proc. International Conf. on Nucl. Data for Sci. and Technol. (1988 Mito), 473 (1988).

6) Y. Uenohara, H. Tsuji and Y. Kanda: "Estimation of Parameters in Nuclear Model Formula for Nuclides of Structural Materials", ibid., 481 (1988).

7) K. Shibata and K. Harada: "Analysis of (n,α) Reaction by Use of Modified TNG Code", ibid., 485 (1988).

8) N. Yamamuro: "Nuclear Cross Section Calculations with a Simplified-Input Version of ELIESE-GNASH Joint Program", ibid., 489 (1988).

9) O. Horibe and H. Chatani: "A New Empirical Rule for the Prediction of Around 14 MeV Neutron Reaction Cross Sections", ibid., 493 (1988).

10) Y. Uenohara, M. Tsukamoto, T. Mori, M. Kihara and Y. Kanda: "Expert System for Evaluation of Experimental Uncertainty from EXFOR File", ibid., 497 (1988).

11) S. Iwasaki, N. Odano, M. Takahashi, M. Kitamura and K. Sugiyama: "Prototying of an Expert System for Nuclear Data Evaluation", ibid., 501 (1988).

12) T. Asami, T. Nakagawa, M. Mizumoto, T. Narita, K. Shibata, S. Chiba, T. Fukahori, A. Hasegawa and S. Igarasi: "Status of Japanese Evaluated Nuclear Data Library Version 3", ibid., 533 (1988).

13) Y. Kanda and Y. Uenohara: "Evaluation of Some Activation Cross Sections Measured by Monoenergetic and Fission Neutrons", ibid., 537 (1988).

14) H. Matsunobu: "Evaluation of the Fission Cross Section for ^{233}U and Comparison with that for ^{235}U", ibid., 553 (1988).

15) T. Murata: "Analysis of Neutron Cross Section of ^{14}N and ^{16}O with an Approximate R-Matrix Theory", ibid., 557 (1988).

16) H. Yamakoshi: "Study on Applicability of Global Neutron Optical Model Potentials to a Nuclear Mass Range from Sodium to Gold and to Energies from 1 to 50 MeV", ibid., 561 (1988).

17) T. Ohsawa and M. Inoue: "Nuclear Data Evaluation of Actinides Relevant to Thorium Fuel Cycle", ibid., 565 (1988).

18) M. Kawai, T. Watanabe, T. Nakagawa, S. Iijima, H. Matsunobu, T. Nishigori, M. Sasaki, T. Sugi and A. Zukeran: "Evaluation and Integral Tests of FP Nuclear Data for JENDL-3", ibid., 569 (1988).

19) T. Fukahori: "Evaluation of Neutron Nuclear Data of ^{11}B", ibid., 587 (1988).

20) S. Iijima, T. Asami, K. Shibata and H. Yamakoshi: "Evaluation of Neutron-Induced Cross Sections of Chromium, Iron and Nickel for JENDL-3", ibid., 627 (1988).

21) T. Nakagawa, Y. Kikuchi and S. Igarasi: "Evaluation of Transplutonium Nuclear Data", ibid., 631 (1988).

Work in Progress

1) Evaluation of Nuclera Data for Am Isotopes

The data of ^{241}Am, ^{242m}Am, ^{243}Am were re-evaluated on the basis of recent experimental data.

(from T. Nakagawa, JAERI)

2) Evaluation of Neutron Nuclear Data for ^{3}He and ^{4}He

Neutron-induced cross sections of ^{3}He and ^{4}He have been evaluated for JENDL-3 in the energy range from 10^{-5} eV to 20 MeV. Enaluated quantities are the total and elastic scattering cross sections of ^{4}He and the total, elastic scattering, (n,p) and (n,d) reaction cross sections of ^{4}He.

(from K. Shibata, JAERI)

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1. RECENT PUBLICATIONS AND REPORTS

[1] H. Gruppelaar, H.A.J. van der Kamp, J. Kopecky and D. Nierop, The REAC-ECN-3 data library with activation and transmutation cross-sections for use in fusion reactor technology, ECN-207 (1988)

[2] J.M. Akkermans and H. Gruppelaar, The pre-equilibrium master equation with angular momentum conservation and its microscopic aspects. Proc. NEANDC Specialists' Meeting on Pre-equilibrium Nuclear Reactions.

[3] H. Gruppelaar, Status of the European Fusion File, Proc. Int. Conf. on Nuclear Data for Science and Technology, May 1988, Mito, Japan, p.455.

[4] J. Kopecky and H. Gruppelaar, The REAC-ECN-3 data library with activation and transmutation cross-sections for use in fusion reactor technology, ibid, p. 245.

[5] J. Kopecky and H. Gruppelaar, European transport activation libraries for fusion reactor technology, 15th Symposium on Fusion Technology (SOFT), 19-23 Sept. 1988, Utrecht.

2. WORK RECENTLY COMPLETED

See above-mentioned publications and reports.
The Ni-evaluation has been completed (except for photon production cross-sections and covariance data).

3. WORK IN PROGRESS

- Evaluation of Ru-102, Ni isotopes.
- Revision of thermal and resolved-resonance range of 65 fission-product isotopes (cooperation with NEA Data Bank).
- Study of direct inelastic-scattering contribution for fission-product nuclides.
- Update of activation cross-section file for fusion-reactor materials [1, 3-5].

4. WORK PLANNED FOR THE FUTURE

- Updata of fission-product cross-sections.
- Work for EFF-2 (European Fusion File) and FENDL (IAEA, ITER).
- Study of microscopic foundation of pre-equilibrium master equation [2].

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Recent Publications and Reports

"The Data Library UKACT1 and the Inventory Code FISPACT"
R. A. Forrest, M. G. Sowerby, B. H. Patrick and D. A. J. Endacott
Paper CH06 presented to International Conference on Nuclear Data for Science and Technology, May 30 - June 3 1988, Mito, Japan.

"U-238 Resolved Resonance Parameters"
M. C. Moxon, M. G. Sowerby, Y. Nakajima and C. Nordborg
Proc. 1988 International Reactor Physics Conference, Jackson Hole, U.S.A., Vol. 1, p.281 (1988).

"FISPACT - User Manual"
R. A. Forrest and D. A. J. Endacott
Harwell Report AERE-M 3654 (1988)

"FISPACT - Program Manual"
R. A. Forrest, D. A. J. Endacott and A. Khursheed
Harwell Report AERE-M 3655 (1988)

Work in Progress

(1) Evaluation of U-238 cross-sections in collaboration with E. Fort (Cadarache), F. H. Fröhner (Karlsruhe) and the NEA Data Bank.

(2) Work to improve the activation cross-section library UKACT1 and the decay data library UKDECAY1 used with the fusion activation inventory code FISPACT.

(3) Calculation of fusion activation with FISPACT and use of the code to identify data needing improvement.

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P.E. HODGSON

I. Recent Publications

1. Neutron Scattering and Reactions on ^{93}Nb from 1 to 20 MeV. By D. Wilmore and P.E. Hodgson. J. Phys. **G14** 485, 1988.
2. Nuclear Reactions. By P.E. Hodgson. A course of eight lectures given at the International Centre for Theoretical Physics, Trieste in March 1988. SMR/284-5.
3. Multistep Processes in Nuclear Reactions. By P.E. Hodgson. Journal of Scientific Research, Banaras Hindu University. **37** 11, 1987.
4. Comparison between Chinese Unified Program (MUP2) and International Nuclear Model Programs. By Su Zong Di and P.E. Hodgson. International Atomic Energy Agency Report INDC (CPR)-012/G + CJ. 1988.
5. Multistep Compound Reactions. By P.E. Hodgson and M.B. Chadwick. Proceedings of the Specialists' Meeting on Pre-Equilibrium Nuclear Reactions, Semmering, Austria. 221, 1988.
6. Multistep Processes in Neutron-Induced Reactions. By P.E. Hodgson. Proceedings of the 1987 Kiev Conference. Vol.2. 76, 1988.

II. Work Recently Completed

1. Analysis of Neutron Total Cross-Sections by Dispersion Relations

Su Zong Di and P.E. Hodgson.

Accepted for publication in Journal of Physics G.

The total cross-sections for the interactions of neutrons with nuclei around 1 MeV are generally rather larger than the values given by global neutron optical potentials, and fits with potentials of standard form can only be obtained with rather unphysical values of the parameters. We have applied the dispersion relations to analyse these data, and find that after including the dispersion term in the real potential the data can be fitted without unphysical parameters.

2. Multistep Analysis of Neutron and Proton Induced Reactions below 20 MeV

M. Chadwick and P.E. Hodgson

The quantum mechanical nuclear reaction theory of Feshbach, Kerman and Koonin has been used to analyse multistep compound reactions for a large range of target nuclei and incident energies. A number of improvements have been made to the way in which the theoretical predictions are evaluated. When calculating transition matrix elements, realistic nuclear single particle wavefunctions have been used, unlike Feshbach's original formulation where the wavefunctions were taken to be constant within the nucleus. The distinguishability of neutrons and protons in the nuclear cascade was also investigated, and it was found that to first order this effect could be accounted for by applying correction factors to the original theoretical expressions for the emission rates. This allowed simultaneous fits of (n,p) and (n,n) reaction cross sections for a given target nucleus. The successful analysis of a large number of nuclear reactions with the reformulated model has enabled the strength of the residual interaction to be determined, and it was found to be rather constant for different nuclei and different excitation energies. There

is evidence to suggest that in nuclear reactions gamma rays are sometimes emitted before equilibrium is attained, resulting in a large cross section of high energy gamma rays. The theoretical mechanism for pre-equilibrium gamma emission is being developed so that these processes can also be included into the multistep formalism.

3. **Pre-Equilibrium Processes on Nuclear Reactions: intercomparison of theories and codes**
   P.E. Hodgson.
   Invited lecture to International Conference on Nuclear Data for Science and Technology, Mito, Japan, May—June 1988.

   The present status of the theories and the associated computer codes that are used to calculate the cross-sections of pre-equilibrium processes in nuclear reactions is reviewed. The principal theories used at the present time are the varieties of exciton models and the quantum-mechanical theories. The codes used to calculate the direct interaction and compound nucleus cross-sections are also mentioned.

4. **Angular Momentum in Multistep Compound Process**
   M.B. Chadwick, P.E. Hodgson and A. Marcinkowski.
   Paper presented to the Fifth International Conference on nuclear Reaction Mechanisms, Varenna, Italy, June 1988.

   The quantum mechanical reaction theory of Feshbach, Kerman and Koonin has been developed to treat angular momentum coupling rigorously in the multistep compound process. The modified theory is used to calculate the escape and damping pre-equilibrium widths and the cross section for the ^{107}Ag(n,p) reaction. The results are compared with those obtained using the original Feshbach formulation.

5. **Multistep Compound Processes in Nuclear Reactions from 9 to 18 MeV**
   M.B. Chadwick, R. Bonetti and P.E. Hodgson.
   Accepted for publication in Journal of Physics G.

   The quantum mechanical reaction theory of Feshbach, Kerman and Koonin has been developed to include neutron and proton distinguishability in the nuclear cascade. The modified theory has been used to analyse the multistep compound emission spectra for (n,n'), (n,p) and (p,n) reactions for incident energies from 9 to 18 MeV. Good agreement with experiment is found in most cases, enabling the strength of the residual interaction to be determined.

6. **Neutron Emission Cross Sections on ^{184}W at 11.5 MeV and 26.0 MeV and the Neutron-Nucleus Scattering Mechanism**
   A. Marcinkowski, R.W. Finlay, J. Rapaport, P.E. Hodgson and M.B. Chadwick.

   Inelastic neutron emission at 11.5 MeV and 26 MeV incident energies has been studied for monoisotopic samples of ^{184}W. Time-of-flight spectra were taken at several angles between 12° and 160° using the beam swinger spectrometer. The data are averaged over 1 MeV energy bins and compared with the quantum-mechanical statistical multistep calculations.

III. Work on Nuclear Model Codes

1. International Nuclear Model Code Intercomparison

Su Zong Di and P.E. Hodgson.

Participation in the International Code Intercomparison organised by the NEA Databank in Paris.

The comparison between Chinese unified program (MUP2) and some international nuclear model programs, SMOG, JIB and WILMORE6, has been completed. The results from the different codes show that the accuracy of MUP2 is comparable with the presently attainable accuracy of international nuclear model codes on optical model calculations and Hauser-Feshbach theory calculations. A report has been finished and submitted to the International Atomic Energy Agency, NEA Databank and the Chinese Nuclear Data Centre.

2. Weisskopf-Ewing and Hauser-Feshbach Internation Nuclear Model Code Intercomparison.

E. Sartori and P.E. Hodgson

The first results of this intercomparison have been received and are being analysed.

IV. Other subjects of related interest

1. Nuclear Momentum and Density Distributions in Nuclei

A.N. Antonov, P.E. Hodgson and I.Zh. Petkov (Oxford University Press). 1988.

2. Nucleon Momentum Distributions

I.Zh. Petkov, A.N. Antonov and P.E. Hodgson

The momentum distributions and nucleons in nuclei are being studied using the flucton and single-particle potential models. The flucton model has now been extended to enable the single-particle wavefunctions and occupation numbers to be calculated. A paper is being prepared for publication, giving the results for ^{16}O, ^{40}Ca and ^{208}Pb.

The flucton model is being further extended to calculate the momentum distributions of alpha-particle sub-structures in the nucleus, and these will be used to calculate the cross-sections of some alpha-emitting reactions for comparison with experimental data.

3. Nucleon-alpha Reactions in Nuclei

E. Gadioli and P.E. Hodgson

The experimental data on nucleon-alpha reactions to discrete and continuum states are reviewed, together with the theories that have been proposed to account for them. At low energies the compound nucleus mechanism predominates, and as the energy increases the pre-equilibrium and direct processes become more likely. These theories are described and the results of typical calculations compared with the experimental data. Particular attention is devoted to J-dependent and spectator effects, and to the competition between the triton pick-up and alpha knockout mechanisms.

P.E. Hodgson

October 1988

Contribution to NNDEN/42 from AEE Winfrith

1 Fission yields (M F James - AEEW, R W Mills - University of Birmingham)

A greatly enlarged database has been produced, including the fission yield data in EXFOR. A preliminary re-evaluation of chain yields has been made, and fractional independent and cumulative yields are being studied.

2 Spin assignments of U238 resonance parameters and the derivation of mean parameters (R W Smith - AEEW)

Work on the analysis of the spins of the U238 resonance parameters derived in the Harwell/NEA Data Bank analysis continued.

It is considered that about 96% of the s-wave resonances have been observed in the analysis, which extends to 10Kev.

An assignment of s-waves has been made which is consistent with the Dyson-Mehta spacing distribution and a Porter Thomas distribution of reduced neutron widths (taking into account missing resonances) with a mean s-wave spacing, D_o of about 20.9ev.

Analysis of the p-wave data is in progress.

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Contributors: L. Geraldo, P. Guenther, R. Lawson, J. Meadows, A. Smith, D. Smith and M. Sugimoto (ANL); T. Djemil and B. Micklich (Univ. of Illinois); and R. Howerton (LLNL).

I. Recent Publications and Reports

D.L. SMITH
Examination of Various Roles for Covariance Matrices in the Development, Evaluation and Application of Nuclear Data, Submitted to the International Conference on Nuclear Data for Science and Technology, Mito City, Japan, May 30-June 3, 1988.

A.B. SMITH, P.T. GUENTHER and R.D. LAWSON
Energy Dependence of the Optical Model Potential for Fast Neutron Scattering from Cobalt, Nuclear Physics A483, 50-76 (1988)

A.B. SMITH, P. GUENTHER and B. MICKLICH
Spectrum of Neutrons Emitted From a Thick Beryllium Target Bombarded With 7 MeV Deuterons, ANL/NDM-103 (1988).

L.P. GERALDO and D.L. SMITH
Some Thoughts on Positive Definiteness in the Consideration of Nuclear Data Covariance Matrices, ANL/NDM-104 (1988).

A.B. SMITH, P.T. GUENTHER, and R.D. LAWSON
Optical-model Calculations for Experimental Interpretation and Evaluation, Practical Considerations, and Fundamental Implications, 2nd IAEA Research Coordination Meeting on Methods for Calculation of Fast-Neutron Nuclear Data for Structural Materials, Vienna, February 15-17, 1988.

P.T. GUENTHER and A.B. SMITH
Double-Differential Scattering of 5-8 MeV Neutrons from Nb, In, Ho, Ta, and Bi, Progress Report on Research Agreement #4412/Cf at the Second Meeting of the Participants of the Coordinated Research Program on Measurement and Analysis of Neutron Emission Spectra for (p,n) and (α,n) Reactions. IAEA, Vienna, Austria, Feb. 8-10, 1988.

D.L. SMITH and L.P. GERALDO
A Vector Model for Error Propagation, Submitted to American Journal of Physics (6/23/88)

A.D. LAWSON, P.T. GUENTHER, and A.B. SMITH
Neutron Scattering and the Fermi Surface Anomaly in ^{51}V, Submitted to Nucl. Phys. (6/88)

S.K. BHATTACHARYYA, D.C. WADE, A.B. SMITH, and H.F. McFARLANE
Neutronics Uncertainties and Validation Requirements for Space Nuclear Power Reactors, Presented at the ANS Summer Meeting, San Diego, California, June 13, 1988

A.B. SMITH, D.L. SMITH, P.T. GUENTHER, J.W. MEADOWS, R.D. LAWSON, R.J. HOWERTON, and T. DJEMIL
Neutronic Evaluated Nuclear Data File for Vanadium, ANL/NDM-105 (1988)

A.B. SMITH, P.T. GUENTHER, AND R.D. LAWSON
Fast-Neutron Elastic Scattering from Elemental Vanadium, ANL/NDM-106 (1988)

L.P. GERALDO, D.L. SMITH, and J.W. MEADOWS
Cross Section Determination for the Mg-24(n,p)Na-24 and Al-27(n,a)Na-24, Bulletin of the American Physical Society 33, 8, 1571 (1988)

P.T. GUENTHER AND A.B. SMITH
Fast-Neutron Double-Differential Scattering in the Mass Region A = 45 to A = 209, Bulletin of the American Physical Society 33, 8, 1567 (1988)

A.B. SMITH, P.T. GUENTHER, AND R.D. LAWSON
Anomalous Ratios to Neutron Elastic Scattering, Bulletin of the American Physical Society 33, 8, 1567 (1988)

J.W. MEADOWS, D.L. SMITH, AND L.P. GERALDO
A Search for Possible Structure in the $^{238}U(n,f)$ Cross Section Near 2.3 MeV, Submitted as a Technical Note to Nuclear Science and Engineering, July 1988.

P.T. GUENTHER, R.D. LAWSON, M. SUGIMOTO, A.B. SMITH, AND D.L. SMITH
An Evaluated Neutronic Data File for Elemental Cobalt, ANL/NDM-107 (1988)

J.W. MEADOWS
The Fission Cross Sections of ^{230}Th, ^{232}Th, ^{233}U, ^{234}U, ^{236}U, ^{238}U, ^{237}Np, ^{239}Pu and ^{242}Pu Relative to ^{235}U at 14.74 MeV Neutron Energy, Annals of Nuclear Energy, Vol. 15, No. 8, pp 421-429 (1988)

II. Work Recently Completed (see above publication list)

III. Work in Progress

A. Completion of documentation of comprehensive evaluated files for vanadium and cobalt.

B. Comprehensive evaluated files for bismuth and zirconium.

C. Partial evaluated files for ^{238}U and beryllium.

D. Evaluated file for $^{93}Nb(n,n')^{93m}Nb$.

IV. Future Plans

A. *Complete items A-D, Section III.*

B. Integral tests of evaluated files for niobium and beryllium.

V. Physical Studies and Model Codes

Continuing attention is being given to exploring the fundamental physical nature of the optical-statistical model. Attention is currently being focused on finding an explanation for certain anomalous ratios which have been observed in elastic scattering data.

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The Applied Nuclear Sciences Group at Los Alamos is involved in the evaluation and calculation of nuclear data for applications, as well as the development of nuclear theory and models for this purpose.

I. Recent Publications and Reports

"Status of Fission Yield Data," T. R. England and J. Blachot,Proc. Int. Conf. on Nucl. Data for Science and Tech., Mito, Japan, 30 May - 3 June 1988, to be published.

"Development and Benchmarking of Higher Energy Neutron Transport Data Libraries," E. Arthur, R. Perry, P. Young, D. Madland, R. MacFarlane, R. Little, R. LaBauve, and M. Bozoian, Proc. Int. Conf. on Nucl. Data for Science and Tech., Mito, Japan, 30 May - 3 June 1988, to be published.

"New Developments in the GNASH Nuclear Theory Code," E. Arthur, P. Young, and C. Kalbach, Proc. Int. Conf. on Nucl. Data for Science and Tech., Mito, Japan, 30 May - 3 June 1988, to be published.

"Development of Nuclear Models for Higher Energy Calculations," M. Bozoian, E. Siciliano, and R. Smith, Proc. Int. Conf. on Nucl. Data for Science and Tech., Mito, Japan, 30 May - 3 June 1988, to be published.

"Calculated Neutron Activation Cross Sections for $E_n \leq 100$ MeV for a Range of Accelerator Materials," M. Bozoian, E. Arthur, R. Perry, W. Wilson, and P. Young, Proc. Int. Conf. on Nucl. Data for Science and Tech., Mito, Japan, 30 May - 3 June 1988, to be published.

"Improved Calculation of the Prompt Fission Neutron Spectrum from the Spontaneous Fission of ^{252}Cf," D. Madland, Proc. Int. Conf. on Nucl. Data for Science and Tech., Mito, Japan, 30 May - 3 June 1988, to be published.

"Nuclear Data Evaluation Based on Direct and Indirect Measurements with General Correlations," D. Muir, Proc. Int. Conf. on Nucl. Data for Science and Tech., Mito, Japan, 30 May - 3 June 1988, to be published.

"Fusion Product Spectra," T. Talley and G. Hale, Proc. Int. Conf. on Nucl. Data for Science and Tech., Mito, Japan, 30 May - 3 June 1988, to be published.

"Monte Carlo Fast-Ion Simulation," T. Talley, Proc. Int. Conf. on Nucl. Data for Science and Tech., Mito, Japan, 30 May - 3 June 1988, to be published.

"Calculated Alpha-Induced Thick-Target Neutron Yields and Spectra with Comparison to Measured Data," W. Wilson, M. Bozoian, and R. Perry, Proc. Int. Conf. on Nucl. Data for Science and Tech., Mito, Japan, 30 May - 3 June 1988, to be published.

"Calculated Proton-Induced Thick-Target Radionuclide Activation Yields and Neutron Yield Spectra for $E_p \leq 50$ MeV with Comparisons to Other Calculations and Measured Data," W. Wilson, E. Arthur, R. Perry, and R. LaBauve, Proc. Int. Conf. on Nucl. Data for Science and Tech., Mito, Japan, 30 May - 3 June 1988, to be published.

"Calculation of ^{235}U(n,n') Cross Sections for ENDF/B-VI," P. Young and E. Arthur, Proc. Int. Conf. on Nucl. Data for Science and Tech., Mito, Japan, 30 May - 3 June 1988, to be published.

"Recent Results in the Development of a Global Medium-Energy Nucleon-Nucleus Optical-Model Potential," D. G. Madland, Proc. OECD/NEANDC Specialists' Meeting on Preequilibrium Nuclear Reactions, Semmering, Austria, 10-12 February 1988, (Ed: B. Strohmaier, OECD Nuclear Energy Agency report NEANDC-245 "U," 1988) p. 103.

"New Model of the Average Neutron and Proton Pairing Gaps," D.G. Madland and J.R. Nix, Nucl. Phys. A476, 1 (1988).

"Scission-Point Fission Model for Calculating Particle and Gamma Spectra and Multiplicities Associated with Medium-Energy Fission," D. G. Madland, Los Alamos National Laboratory informal report T-2-IR-88-1 (1988).

"Parameter Correlations and Ambiguities in Dirac Phenomenology," R. E. Kozack and D. G. Madland, Bull. Am. Phys. Soc. 33, 1560 (1988).

"Calculation of Particle and Gamma Spectra from Medium-Energy Fission," M. Bozoian, E. D. Arthur, D. C. George, and D. G. Madland, Bull. Am. Phys. Soc. 33, 1580 (1988).

"Recent Improvements in the Calculation of Prompt Fission Neutron Spectra: Preliminary Results," D. G. Madland, R. J. LaBauve, and J. R. Nix, Proc. IAEA Consultants' Meeting on the Physics of Neutron Emission in Fission, 24-27 May 1988, Mito, Japan (in press).

"Optical Potentials for Nucleon Scattering by ^{208}Pb at Intermediate Energies," R. E. Kozack and D. G. Madland, submitted to Phys. Rev. C.

"The Status of Nuclear Data Evaluations for Version VI of ENDF/B," P. G. Young, Proc. Int. Reactor Physics Conf., Jackson Hole, Wyoming, 18-22 Sept. 1988., p. 243.

"Evaluation of the $^{7}Li(n,n't)^{4}He$ Cross Section for ENDF/B-VI and Application to Uncertainty Analysis," P. G. Young, J. W. Davidson, and D. W. Muir, Proc. Eighth Topical Meeting on the Tech. of Fusion Energy, Salt Lake City, Utah, 9-13 Oct. 1988, to be published.

"ENDF/B-VI Nuclear Data Evaluations for Fusion Applications," C. L. Dunford, D. C. Larson, and P. G. Young, Proc. Eighth Topical Meeting on the Tech. of Fusion Energy, Salt Lake City, Utah, 9-13 Oct. 1988, to be published.

"The Status of ENDF/B-VI," R. Roussin, C. Dunford, R. McKnight, and P. G. Young, Proc. Seventh Int. Conf. on Radiation Shielding, Bournemouth, England, 16 Sept. 1988, to be published.

"Adaptation of the Multistage Preequilibrium Model for the Monte Carlo Method," M. Bozoian and R. E. Prael, Bull. Am. Phys. Soc. 33, 1581 (1988).

"Preequilibrium Exciton Model with Quasi-elastic Component," R. D. Smith, M. Bozoian, and E. D. Arthur, Bull. Am. Phys. Soc. 33, 1601 (1988).

"A Review of Phenomenological Models for Angular Distributions and Their Comparisons with Generalized Preequilibrium Models," M. Bozoian, Proc. Specialists' Meeting on Preequilibrium Nuclear Reactions, Semmering, Austria, 10-12 Feb. 1988, (Ed: B. Strohmaier, OECD Nuclear Energy Agency report NEANDC-245 "U," 1988) p. 129.

"$^{7}Be(n,p)^{7}Li$ Total Cross Section from 25 MeV to 13.5 keV," P.E. Koehler, C.D. Bowman, F.J. Steinkruger, D.C. Moody, G.M. Hale, J.W. Starner, S.A. Wender, R.C. Haight, P.W. Lisowski, and W.L. Talbert, Phys. Rev. C 37, 917 (1987).

"Nuclear Effects on the Eigenvalues of the dtμ Molecule," M.C. Struensee, G.M. Hale, R.T Pack, and S.J. Cohen, Phys. Rev. A 37, 340 (1987).

II. Work Recently Completed

Development and application of extended formats and parameterizations required to describe coupled energy-angle distributions.

Revision of $n+^{7}Li$ covariance analysis complete for ENDF/B-VI.

Completed development of global nucleon-nucleus optical-model potential based on Al, Fe, and Pb data and covering the neutron and proton energy range 50-400 MeV.

Completed preliminary evaluations of proton-induced transport cross sections to 100 MeV for ^{12}C, ^{16}O, and ^{27}Al.

Completed preliminary theoretical analysis of neutron reactions with ^{235}U for E_n = 0.01 to 20 MeV.

Completed nucleon-induced fission model for calculating neutron spectra from fission fragments.

Completed two exciton preequilibrium model codes: PREEQ1 which calculates particle emission from a compound nucleus using the Monte Carlo technique, and RAQUEL, which includes a quasi-elastic component for the 2p1h configuration.

Completed calculations of neutron-activation cross sections to 100 MeV for 84 accelerator materials.

Completed calculations and data comparisons of α-induced thick target neutron yields and spectra for target nuclides with $Z \leq 15$.

III. Work in Progress

Theoretical analysis of neutron-induced reactions on ^{237}Np and ^{238}U for E_n = 1-100 MeV and proton-induced reactions on ^{238}U for E_p = 5-100 MeV.

Extension of deformed rare-earth and actinide optical potentials to E_n = 30-40 MeV.

Theoretical calculation of fission neutron spectra from neutron- and proton-induced fission of ^{238}U to 100 MeV.

Development of medium-energy Dirac optical potentials.

Theoretical analysis of n+^{239}Pu reactions to 20 MeV for ENDF/B-VI.

R-matrix analyses for the ^{7}Li and ^{11}B systems, including new data and theoretical developments, that will be used to provide neutron cross sections for the ^{6}Li and ^{10}B ENDF-VI evaluations.

Provide more accurate inverse cross sections for PREEQ1 code, and investigate RPA correlations, collisional damping, 2-step contributions and possible better angular dependence than free scattering for exciton contributions for RAQUEL code.

Fission product yield evaluations.

Six-group fits plus spectra for delayed neutrons for 43 fuels completed; results now have to be put into ENDF/B-VI format. Precursor data for 271 nuclides also complete but not yet in ENDF/B-VI format.

IV. *Work Planned for the Future*

Theoretical analyses and evaluations will continue for materials not included in the first issue of ENDF/B-VI.

Model and nuclear theory development effort into the medium-energy range will continue.

V. Work on Codes

See entries under above items I, II, and III.

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I. Recent publications and reports

none

II. Work recently completed

The PHOTX library of evaluated photon cross sections was made available to the Radiation Shielding Information Center (RSIC) by the U.S. National Bureau of Standards. The library has data for 100 elements.

III. Work in progress

The PHOTX library is being placed in the RSIC Data Library Collection.

IV. Work planned for the future

The data from the PHOTX library will be placed in ENDF/B format in support of ENDF/B-VI.

A retrieval code for PHOTX is being developed.

PHOTX will be make available by RSIC.

Compiled by: D. K. Trubey

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Compiler: D. C. Larson

1. Recent publications and reports

G. de Saussure, L. C. Leal, R. B. Perez, N. M. Larson, and M. S. Moore, "A New Resonance-Region Evaluation of Neutron Cross Sections for U-235," to be published in Proceedings of the International Reactor Physics Conference, American Nuclear Society, Jackson Hole, WY, September 18-21, 1988.

H. Derrien and G. de Saussure, "Current Plutonium Cross-Section Evaluations in the Resolved Resonance Region," to be published in the Proceedings of the International Reactor Physics Conference, American Nuclear Society, Jackson Hole, WY, September 18-21, 1988.

R. B. Perez, G. de Saussure, L. C. Leal, and Roger Macklin, "On the Unresolved Resonance Region Representation of Neutron Induced Cross Sections," to be published in the Proceedings of the International Reactor Physics Conference, American Nuclear Society, Jackson Hole, WY, September 18-21, 1988.

J. K. Dickens, "SCINFUL: A Monte Carlo Based Computer Program to Determine a Scintillator Full Energy Response to Neutron Detection for E_n Between 0.1 and 80 MeV: User's Manual and Fortran Program Listing," ORNL-6462 (March 1988).

C. L. Dunford, D. C. Larson, and P. G. Young, "ENDF/B-VI Nuclear Data Evaluations for Fusion Applications," to be published in the Proceedings of the Eighth Topical Meeting on Technology of Fusion Energy, American Nuclear Society, Salt Lake City, UT, October 9-13, 1988.

D. M. Hetrick, C. Y. Fu, and D. C. Larson, "ENDF/B-VI Evaluations for Isotopes of Cr, Fe, Ni, and Cu, and for natural Pb," to be published in the Proceedings of the Eighth Topical meeting on the Technology of Fusion Energy, American Nuclear Society, Salt Lake City, UT, October 9-13, 1988.

R. L. Macklin, "Search for ^{136}Xe Resonance Neutron Capture," ORNL/TM-10766 (May 1988).

G. de Saussure and J. H. Marable, "Uncertainties of the ENDF/B-V 238-U Unresolved Resonance Parameters in the Range 4 keV $<$ E $<$ 45.18 keV (MAT=1398, MF=2, MT=251)," submitted to *Nucl. Sci. Eng.*

J. K. Dickens, "SCINFUL: A Monte Carlo Based Computer Program to Determine a Scintillator Full Energy Response to Neutron Detection for E_n Between 0.1 and 80 MeV: Program Development and Comparisons of Program Predictions with Experimental Data," ORNL-6463 (June 1988).

H. Derrien and G. de Saussure, "Current Plutonium Cross-Section Evaluations in the Resolved Resonance Region," to be published in the Proceedings of the International Reactor Physics Conference, American Nuclear Society, Jackson Hole, WY, September 18-21, 1988.

C. Y. Fu, "A Re-Evaluation of ^{32}S(n,p) Cross Sections From Threshold to 5 MeV," to be published in the Proceedings of the ANS Topical Conference on Advances in Nuclear Computation and Radiation Shielding, Santa Fe, New Mexico, April 9-13, 1989.

R. L. Macklin, R. R. Winters, and D. M. Schmidt, "Resonance Neutron Capture by Argon-40," submitted to *Astronomy and Astrophysics.*

D. K. Trubey, M. J. Berger, and J. H. Hubbell, "Photon Cross Section for ENDF/B-VI," to be published in the Proceedings of the ANS Topical meeting on Advances in Nuclear Engineering Computation and Radiation Shielding, Santa Fe, New Mexico, April 9-13, 1989.

L. C. Leal, G. de Saussure, and R. B. Perez, "Analysis of the ^{235}U Neutron Cross Sections in the Resolved Resonance Range," to be published in the Proceedings of the ANS and National Bureau of Standards Conference on Fifty Years with Nuclear Fission, Gaithersburg, MD, April 26-28, 1989.

R. W. Peelle and D. W. Muir, "Extended Covariance Data Formats for the ENDF/B-VI Differential Data Evaluation," to be published in the Proceedings of the Specialists' Meeting on the Application of Critical Experiments and Operating Data to Core Design via Formal methods of Cross Section Data Adjustment, Jackson Hole, WY, September 23-24, 1988.

C. M. Perey, F. G. Perey, J. A. Harvey, N. W. Hill, N. M. Larson, and R. L. Macklin, "^{58}Ni + n Transmission, Differential Elastic Scattering and Capture Measurements and Analysis from 5 to 813 keV," ORNL/TM-10841 (September 1988).

2. Work recently completed

   a. A comprehensive analysis of ^{58}Ni transmission, capture and differential elastic-scattering data in the resonance region has been completed, and a report submitted for publication. A modification to the low-energy resonance parameters was done for the ENDF/B-VI evaluation so the thermal capture and scattering values are reproduced, and no background file is needed in the resonance region from 10^{-5} eV to 810 keV.

   b. Isotopic evaluations for ^{58,60,61,62,64}Ni have been completed and submitted for ENDF/B-VI. Nuclear model code evaluations form the basis for the evaluations of the minor isotopes, with particular attention to any important cross sections. The ^{58,60}Ni evaluations are based on a combination of model calculations and experimental data. Energy balance

is ensured for each reaction at all energies to better than 1%. The new File 6 formats contain sufficient information for direct calculation of KERMA factors, heating, etc. The new Reich-Moore formats are being used for the resonance parameters, based on recent ORELA data for ^{58,60}Ni.

c. High-resolution scattering measurements at six angles in the resonance region from 15–1000 keV have been completed for samples of ^{54}Fe, ^{52}Cr, and ^{204}Pb.

d. A simultaneous analysis of total, capture and scattering data for the resonance region of ^{56}Fe is well advanced and preliminary results have been used in the ENDF/B-VI evaluation. Use of low-energy transmission data down to 40 ev has yielded a set of resonance parameters which yield the correct scattering and capture thermal cross sections, and no background files are needed from 1.0^{-5} eV to 850 keV for the total, and to 400 keV for the capture.

e. Isotopic evaluations for ^{50,52,53,54}Cr have been completed and submitted for ENDF/B-VI. Comments for Ni given under b. are appropriate here, except that the resonance parameters for ^{50,52,53}Cr are taken from GELINA results at Geel, and ^{54}Cr resonance parameters are from Mughabghab's compilation.

f. Analysis of the high resolution ORELA capture measurement on ^{238}U is continuing, as a collaborative effort between Harwell, University of Tennessee, and ORELA. Results are expected to be available by March for inclusion in the new ^{238}U evaluation for ENDF/B-VI.

g. The new SCINFUL code, used for neutron scintillation-detector calibration and efficiency calculations, has been extended to be useful for neutron energies from 0.1 to 80 MeV, and two reports document the methods, code operation, and extensive comparisons with experimental response function data from the literature.

h. Isotopic evaluations for ^{54,56,57,58}Fe have been completed and submitted for ENDF/B-VI. Comments for Ni given under b. are appropriate here also.

i. Isotopic evaluations for ^{63,65}Cu have been completed and submitted for ENDF/B-VI. Resonance parameters were taken from Mughabghab's compilation. Again, see b. for details.

j. Isotopic evaluations for ^{206,207,208}Pb have been completed and submitted for ENDF/B-VI. Pointwise data are given in the resonance region. See b. for details.

k. The ENDF/B-V evaluation for carbon has been modified to include resonances in ^{13}C below 2 MeV based on R-matrix analysis, and the (n, n') and $(n, n'3a)$ cross sections have been changed to yield improved values of KERMA.

l. SAMMY resonance parameter analyses of transmission and fission data for ^{239,241}Pu have been completed to 1 keV for ^{239}Pu and 300 eV for ^{241}Pu. These results will be incorporated in the ENDF/B-VI evaluations for these materials.

m. A new measurement of capture in the 1.15-keV resonance in ^{56}Fe has been completed at 20-m using C_6F_6 and C_6D_6 detectors. Incorporating

a careful modeling of the detectors and environs in an electron transport calculation of the response function and efficiency of the detector system, a result of 63.8 ± 2.5 meV has been obtained for the neutron width, in good agreement with the result measured in transmission.

Other work completed in the past year is covered in the Publications section.

3. Work in progress

a. A measurement of the $^{10}B(n,\alpha_1)/^{10}B(n,\alpha_0)$ ratio from 50 keV to 1 MeV is underway at ORELA. Solid state detectors are being used to detect the alpha particles. Hydrogen in the form of polyethylene inside the solid state detectors caused problems in the previous attempt. This problem has been alleviated and measurements are underway again.

b. The capture system in use at the ORELA 40-m flight path for several years is being modified and upgraded. The C_6F_6 detectors will be replaced by C_6D_6 detectors, and mass around the detectors and samples is being minimized to reduce effects in the capture detectors of electron-produced gamma rays from the environs.

c. Reich-Moore resonance parameter analysis with SAMMY is currently underway for new transmission and fission data for ^{235}U. The goal is to extend the resolved resonance region from 83 eV to 2 keV for inclusion in ENDF/B-VI so self-shielding effects in reactors may be better predicted.

d. A new high resolution measurement of the ^{235}U and ^{239}Pu fission cross sections in the resonance region is nearing completion. The resonance parameter analyses discussed above were limited by the energy resolution of the fission cross sections, and the new measurements at the 85-m flight path will have the best resolution yet reported above 300 eV.

e. A new multicrystal spectrometer, eventually to contain as many as 36 BaF_2 crystals, is under construction. Preliminary measurements and background determinations have begun with the 16 crystals now available. Initial measurements will be very high precision determinations of the ratio of capture to fission in ^{239}Pu and ^{235}U, and studies of fission gamma-ray multiplicities.

f. A system based on NE-213 scintillation detectors to measure neutron and gamma-ray emission cross sections for E_n = 1–20 MeV has been completed. Three detectors will measure energy and angle dependent spectra using pulse-shape discrimination to distinguish the neutrons and gamma rays. Preliminary measurements are scheduled to begin in November 1988. A new data acquisition system for this experiment based on an IBM PS-2 Model 80 PC and an in-house interface has been completed and tested. In a three-parameter mode (ph,tof,psd), maximum count rates of 2000 c/s are presently obtained.

4. Work planned for the future

   a. The upgraded capture gamma-ray system at 40-m will be used to measure capture cross sections and spectra for structural materials.

   b. High resolution transmission measurements will be done for ^{57}Fe, ^{52}Cr and ^{63,65}Cu.

   c. The possibility of doing more high resolution 200-m transmission measurements on ^{238}U will be investigated, this time using cooled samples.

   d. Measurements of neutron and gamma ray spectra as a function of angle and energy will continue, using the new system discussed earlier. Samples of chromium, nickel and lead will be measured.

   e. The high resolution (n, xg) production cross-section measurements will continue, with the next sample being Ti.

   f. Evaluations done for ENDF/B-VI will be followed through Phase I and II checking, and appropriate adjustments made. Covariance evaluations and remaining documentation for the evaluations will be completed. Evaluations of the tin isotopes and silicon isotopes will commence.

5. Work on nuclear model codes

   a. The TNG code, a multi-step Hauser-Feshbach (H-F) code with a precompound component consistent with H-F methodology, is being improved such that the level density used in the H-F part and in the precompound part are consistent. The improvement involves calculating the particle-hole level density and its spin distribution using the BCS methodology for two kinds of Fermions.

   b. The SAMMY manual is currently undergoing revision to include new features incorporated the past three years. A multiple scattering correction option will be added to SAMMY for analysis of capture data.

EUROPEAN FUSION FILE (EFF)

ADDRESS: Netherlands Energy Research Foundation ECN
P.O. Box 1
1755 ZG PETTEN
The Netherlands

NAMES: H. GRUPPELAAR, J. KOPECKY, D. NIEROP (file management).

The EFF project is part of the European Fusion Technology Programme of the European Community (EC). The following laboratories are contractors in the EFF project: CEA (Saclay), ECN (Petten), ENEA (Bologna) and KfK (Karlsruhe). Moreover, JRC (Ispra) and CBNM (Geel) are involved as EC institutes. The project is directed by the NET team at Garching and by EC (Brussels); the file maintenance and management is performed at ECN (Petten). Other European laboratories are also involved: SCK/CEN (Mol) with an experimental programme performed at CBNM, the UK laboratories Harwell, Birmingham and Culham (JET), ENEA (Frascati), KFA (Jülich), IKE (Stuttgart) and EIR (Würenlingen). Furthermore, technical support is received from the NEA Data Bank.

1. RECENT PUBLICATIONS AND REPORTS

[1] H. Gruppelaar, Status of the European Fusion File, Proc. Int. Conf. on Nuclear Data for Science and Technology, May 1988, Mito, Japan.

[2] H. Gruppelaar, H.A.J. van der Kamp, J. Kopecky and D. Nierop, The REAC-ECN-3 data library with activation and transmutation cross-sections for use in fusion reactor technology, ECN-207 (1988).

2. WORK RECENTLY COMPLETED

- Distribution of EFF-1 file to European users.
- Compilation of GEFF-1 multi-group constant library (VITAMIN-J format).

3. WORK IN PROGRESS

Revision of cross-sections for ^{7}Li, Be, Al, Fe, Cr, Ni, Pb by various laboratories. Work on activation file for fusion reactor technology [2].

4. WORK PLANNED FOR THE FUTURE

- Compilation of EFF-2 data library [1].
- Compilation of a European Activation File (EAF) for fusion technology [1, 2].

5. DISTRIBUTION

Since a large part of EFF-1 consists of evaluations taken from JEF-1, the same distribution policy as for JEF-1 (NEA Data Bank Member countries), is followed. Different evaluations in EFF-1 are given for ^{7}Li, ^{9}Be, Al, Si and Pb. The lead evaluation has been made available for general distribution (benchmark testing, etc.) and can be requested from the NEA Data Bank. The package consists of the EFF-1 evaluation for MF6 data, an equivalent ENDF-V version (without angle-energy correlations for continuum reactions) and a version with isotropic angular distributions for continuum reactions. The GEFF-1 data file for lead has also been included.

CENTRAL BUREAU FOR NUCLEAR MEASUREMENTS
Physics Division

Address :Commission of the European Communities,
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Author :T.B.Ryves

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RECENT PUBLICATION:

A simultaneous evaluation of some important cross-sections at 14.7 MeV

by T.B. Ryves, visiting scientist, NPL Teddington Middlesex UK

Cross-section values of ^{27}Al(n,alpha), ^{56}Fe(n,p), ^{63}Cu(n,2n), ^{65}Cu(n,2n), ^{197}Au(n,2n), ^{93}Nb(n,2n), ^{32}S(n,p), ^{1}H(n,n), ^{27}Al(n,p), ^{59}Co(n,alpha), ^{235}U(n,f), and ^{238}U(n,f) at 14.7 MeV are evaluated simultaneously by the weighted least squares method taking into account the correlations between the measurement uncertainties.

Submitted as: EUR-11912EN Report
to: European Applied Research Reports,
Nuclear science and Technology Section.

IAEA Nuclear Data Section
P.O. Box 100, A-1400 Vienna, Austria
Tel: (0222)2360-1710 Telex: 1-12645

Names: V. Goulo, M. Lammer, H.D. Lemmel
P.K. McLaughlin, O. Schwerer

New evaluated data files received:

Chinese evaluations of 95-Am-241, 97-Bk-249, 98-Cf-249. These are being checked and converted from ENDF-4 to ENDF-5.

BROND - the USSR evaluated nuclear data library. The version BROND-NDS1 has been distributed. The tape is accompanied by the document IAEA-NDS-90 Rev. 1. The English translation of the Russian documentation has been issued as INDC(CCP)-283.

ENDF processing codes:

The 1988 version of the ENDF pre-processing codes is being worked on and will be released soon for mainframe and PC.

Publications:

INDC(VN)-6. P.Z. Hien, H.N. Lien, Pre-equilibrium emission of protons and isotopic effect in the fast neutron induced (n,p) reactions on heavy elements.

INDC(HUN)-25. A.V. Ignatyuk et al., An analysis of the Al-27(n,t) excitation function.

INDC(NDS)-201. V. Goulo, A. Lorenz, Summary report on the IAEA specialists' meeting on the fusion evaluated nuclear data library related to the ITER activity, Vienna, 16-18 November 1987.

INDC(BZL)-23 and 24. E.S. Chalhoub, J. Anaf, RGENDF, on interface program between the NJOY code and codes using multigroup cross-sections. - COMPAR, a system for comparing multigroup cross-sections generated by NJOY, GROUPIE, FLANGE-2, ETOG-3 and XLACS. (Translated by IAEA from Portugese into English.)

INDC(CSR)-14. E. Betak et al., Pre-equilibrium decay calculations based on the realistic level scheme.

INDC(BZL)-28. R. Paviotti-Corcuera, A. Trkov, Intercomparison of integral data derived from evaluated data libraries of the actinides.

INDC(BZL)-29. R. Paviotti-Corcuera, M. de Moraes, Validation of actinide nuclear data from ENDF/B-V, INDL/A-83 and JENDL-2.

INDC(YUG)-11. A. Trkov, Comparison of evaluations for U-235, Pu-239, Pu-240, Pu-241 and Pu-242 with integral measurements.

NEA DATA BANK

Address: B.P. 9
91191 Gif-sur-Yvette CEDEX
FRANCE

Joint Evaluated File (JEF)

1. Two meetings of the JEF Working Group on Evaluations for JEF-2 were held during 1988, one on 12th April and one on 14th November, at the NEA Data Bank.

   Both meetings reviewed the status of the new evaluations planned for JEF-2. Good progress had been made for the major isotopes (U-235, U-238, Pu-239, Pu-241, Cr-, Fe-, and Ni-isotopes), and it was planned to issue a first preliminary file of the these new isotopes for JEF-2 in February 1989. This file should so far only be used for basic benchmark testing.

   The work on the Fission products was almost completed. New experimental data, which were not consistent with present evaluations of Sodium were announced, as well as new resonance parameters of Am-242M from Karlsruhe.

   Concerning data processing, it was decided that the NEA Data Bank would investigate the interest in holding a seminar on the use of the NJOY code. Preliminary dates for this seminar would be 20th and 21st June 1989. We have good hopes that one of the authors, R. MacFarlane, will be able to participate.

2. Two meetings were also held with the JEF Working Group on Radioactive Decay and Fission Yield Data.

   Both meetings reviewed the present data available and discussed selection criteria for new data to be included in the JEF-2 file.

3. A JEF Scientific Coordination Group (SCG) Meeting was held on 15th November 1988 at the NEA Data Bank.

   A proposal for a closer collaboration between the ENDF, JEF and JENDL evaluation efforts was discussed, at the last meetings of the NEA Nuclear Data Committee (NEANDC) and the NEA Committee for Reactor Physics (NEACRP), and a Task Force was set up to investigate the objectives and the method of work to be employed in the cooperation. The NEANDC/NEACRP proposal was reviewed and endorsed by the SCG, providing that a few technical details could be clarified.

Conference proceedings received or published at the NEA Data Bank

Proceedings of the NEANDC Specialists' Meeting on Delayed Neutron Properties, held at the Univ. of Birmingham, U.K., 15th-19th September 1986. (Editor D.R. Weaver).

Proceedings of the NEANDC Specialists' Meeting on Pre-equilibrium Nuclear Reactions, held at Semmering, Austria, 10th-12th February 1988. (Editor B. Strohmaier)

Proceedings of the International Conference on Nuclear Data for Science and Technology, held at Mito, Japan, 30th May - 3rd June 1988. (Editor S. Igarasi)

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