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*****************************************
******************************* BIB-SECTI
*
* REFERENCE   (C,68WASH,2,885,6803) PRO
*              CONTRIBUTION.
*             (P,EANDC(E)-89,37,6802) T
*             (J,NP/A,118,9,6805) FINAL
*              MEASUREMENTS.
* AUTHOR      (H.K.VONACH,F.G.VONACH,H
* TITLE       -PRECISION MEASUREMENTS O
*              OF (N,P),(N,A) AND (N,2N
*              13.5 - 14.7 MEV NEUTRONS
* INSTITUTE   (2GERMUN)
* N-SOURCE    (D-T  ) BOMBARDMENT OF A
*              DEUTERONS. A RANGE OF IN
*              WERE USED BY VARYING THE
* FACILITY    (VDG  ) 400KEV VAN DE GRA
*              FUR STRAHLENFORSCHUNG.
* METHOD      (ACTIV) GAMMA PULSES EX
*              TA-180M WHERE BETAS HER
* PART-DET    (DG   ) DECAY GAMMAS.
* SAMPLE      .NATURAL MATERIALS. ME
*              SAMPLES WERE PLACED A
*              CORRESPONDING TO 30 M
*              ENERGY, AND SURTENDED
*              DISTANCE OF 100MM
* CORRECTION  .ANGULAR DEPENDENT NE
*              ELASTICALLY SCATTERED
*              SCATTERING CONTRIBUTI
*              DECAY CORRECTIONS.
* ERR-ANALYS  .SYSTEMATIC ERRORS, TA
*              ATTENUATION CORRECTION
*              (0.05 PC), DECAY CORRE
*              SHIFTS (0.1 PC). MAXIMU
*              THAN 0.9 PERCENT. STATIS
*              IN THE TOTAL ERROR.
* DETECTOR    (NAICR) 5X5INCH WELL CRYS
*             (PROPC) CH4 FLOW COUNTER
*              TA-180M.
* STATUS      .FROM TABLES IN CONFERENC
* HISTORY     (781017C) PDJ. RECOMPILED
*             (790219E)
*             (800115A) REACTION STRING
*              022 AND 023 CHANGED.
*             (800115E)
*             (800424A) DATA READINGS
*             (800603E)
*
** END BIB-SECTION ******************
*****************************************
******************************* BIB-SECTI
*
* REACTION    (23-V-51(N,A)21-SC-48,,SI
*              RATIO TO THE 14.7 MEV CR
* STATUS      .PUBLISHED TABLE.
* HISTORY     (781018C) PDJ.
*             (790219E)
*             (800424A) DATA HEADINGS
*             (800603E)
*
** END BIB-SECTION ******************

** NO COMMON-SECTION ****************
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        EN-          EN-ERR      DATA
        MEV          MEV         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

** END DATA-SECTION ****************
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NNDEN/41

NEUTRON NUCLEAR DATA EVALUATION NEWSLETTER

NEA DATA BANK
BANQUES DE DONNÉES DE L'AEN

March 1988

NNDEN/41

NEUTRON NUCLEAR DATA EVALUATION NEWSLETTER

NEA DATA BANK
BANQUES DE DONNÉES DE L'AEN

March 1988

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NEUTRON NUCLEAR DATA EVALUATION NEWSLETTER

NNDEN/41

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 on evaluation activities and nuclear model codes have been received from:

		Page
BULGARIA	Institute for Nuclear Research, Sofia	7
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FRANCE	CEN, Bruyères-le-Châtel	9
	CEN, Cadarache	11
GERMAN DEMOCRATIC REPUBLIC	Dresden	12
INDIA	Indira Gandhi Centre, Kalpakkam	16
ITALY	ENEA, Bologna	18
NETHERLANDS	ECN, Petten	20
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	Nuclear Physics Laboratory, Oxford	22
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	NNDC, Brookhaven	31
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IAEA	Nuclear Data Section, Vienna	43
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The next issue of NNDEN has been scheduled for December 1988 and contributors are asked to send in their reports by 15th November 1988.

NEA Data Bank, March 1988

NEW EVALUATIONS

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

NUCLIDE	DATA TYPE	ENERGY RANGE	PAGE		
			A	B	C
H-1	many		34		
Be	(n,tot),(n,SCT)			29	
B-11	many			34	
C-12	many		34		
O-16	many		34		
Al-27	many		34		
Si	res.par.(n,γ)		12		
Si-28	many		34		
Ca-40	many		34		
V	many		29		
Cr-50	many	10^{-5}-20MeV		39	
Cr-51	decay data		25		
Cr-52	many	10^{-5}-20MeV		39	
Cr-53	many	10^{-5}-20MeV		39	
Cr-54	many	10^{-5}-20MeV		39	
Fe	(n,γ)	1MeV-15MeV	19		
Fe-54	many	10^{-5}-20MeV		39	
Fe-56	many		34		
Fe-56	many	10^{-5}-20MeV		39	
Fe-57	many	10^{-5}-20MeV		39	
Fe-58	many	10^{-5}-20MeV		39	
Co-59	many	14 MeV		23	
Co-59	(n,γ)		27		
Co	many		29		
Co	res.par.			29	

NUCLIDE	DATA TYPE	ENERGY RANGE	PAGE		
			A	B	C
Ni-58	many	650KeV-20MeV		29	
Ni-58	many	1MeV-20MeV		36	
Ni-58	many	10^{-5}-20MeV		38	
Ni-60	many	10^{-5}-20MeV		38	
Ni-60	many	1MeV-20MeV		36	
Ni-61	many	10^{-5}-20MeV		38	
Ni-62	many	10^{-5}-20MeV		38	
Ni-64	many	10^{-5}-20MeV		38	
Ni-isot	many	10^{-5}-20MeV		20	
Zn-64	many		34		
Zn-65	decay data		25		
Zn-66	many		34		
Zn-68	many		34		
Zr	many			29	
Nb-93	DDX	fast		13	
Nb-93	many	14MeV		23	
Nb-93	many	1MeV-20MeV	23		
Sn-116	many		9		
Sn-120	many		9		
Eu-151	many			34	
Eu-153	many			34	
Ho-165	many			34	
Tm-169	many			34	
Hf-isot	res.par.			26	
W-184	many	<26MeV			10
Au-198	decay data		25		
Pb	res.par,(n,γ)		12		
Pb-nat	many	10^{-5}-20MeV	37		
Bi	many		29		
Bi	res.par.			29	
Ru-102	many	10^{-5}-20MeV		20	

NUCLIDE	DATA TYPE	ENERGY RANGE	PAGE		
			A	B	C
Th-232	many	20KeV-10MeV	16		
U-233	many			16	
U-235	res.par.	10^{-5}-20MeV		39	
U-235	many	resolved res.		11	
U-238	many	5MeV-20MeV			11
U-235	νp				11
U-235	neut.multiplicity		31		
U-238	DDX	fast		13	
U-238	many	20KeV-10MeV	16		
U-238	many			21	
U-238	many	<20MeV		29	
U-238	neut.multiplicity		31		
Pu-238	neut.multiplicity		31		
Pu-239	many	KeV-20MeV	11		
Pu-239	res.par.	10^{-5}-20MeV		39	
Pu-240	many		36		
Pu-241	many	unresolved res.	7		
Pu-241	many	<1KeV		11	
Pu-241	νp	resolved and unresolved res.		11	
Cf-252	neutr.spect.			8	

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BULGARIAN ACADEMY OF SCIENCES
Names:N.Janeva, N.Kojumdjieva, N.Savova, S.Toshkov, G.Georgiev, N.Tchikov
Address: Institute for Nuclear Research and Nuclear Energy, Blvd. Lenin 72, 1784 Sofia, Bulgaria

Recent publications:

1. ^{239}Pu Neutron Cross-sections in the Resolved Resonance Region. V.V.Kolesov, A.A.Lukyanov, S.Toshkov, N.Janeva. Bulg.J.Phys. 13 (1986), 4, 355.
2. Nuclear Data for ^{235}U, ^{238}U, and ^{239}Pu in the Unresolved Resonance Region. A.A.Vankov, V.F.Ukraintsev, N.Janeva, S.Toshkov, A.Mateeva. Nuclear Science and Engineering: 96, 122-136(1987).

Work recently completed or in progress

- Statistical modelling of resonance averaged cross sections in one channel case on the ground of reduced R-matrix theory. The corresponding analitical method is performed(N.Savova, N.Janeva, A.A.Lukyanov).
- Evaluation of ^{241}Pu neutron group constants in the unresolved resonance region - energy averaged neutron cross sections, self-shielding factors, and their temperature dependence(N.Kojumdjieva, N.Savova, S.Toshkov, N.Janeva)
- Investigation of the response function of the multisectional scintilation detector "Romashka" for application of gamma-ray multiplicityspectrometry in measurement of nuclear data (G.Georgiev T.Madjarski, G.V.Muradyan, N.Stancheva, N.Tchikov, N.Janeva)

KfK KARLSRUHE

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Institut für Neutronenphysik und Reaktortechnik
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Work in Progress

1. Watt Spectrum Fit to ^{252}Cf prompt fission neutron data

Data from ten recent (post-1982) measurements of the ^{252}Cf prompt fission neutron spectrum have been fitted with four types of theoretical models: (1) a Maxwell spectrum, (2) a Watt spectrum, (3) a superposition of two Watt spectra representing a typical pair of fission fragments, and (4) a relativistic generalisation of (3). Instrumental resolution has been accounted for by exploitation of the fact that the Watt spectrum is mathematical identical with the free-gas Doppler broadening kernel, so that instrumental broadening is equivalent to a slight rise in nuclear temperature. The Maxwell spectrum was found inadequate, as expected, but a Watt spectrum with parameters

$$T_W = 1.175 \pm 0.005 \text{ MeV}, \; E_W = 0.359 \pm 0.009 \text{ MeV}$$

fits all data well up to 20 MeV, except for those above 17 MeV from one set, with a chi-square that indicates no need for a more refined model. The superposition of two Watt spectra and the relativistic generalisation do not improve the fit [1].

When Mannhart's [1] evaluated point data became available they were subjected to the same fitting procedure. The Watt spectrum obtained had the parameters

$$T_W = 1.174 \pm 0.008 \text{ MeV}, \; E_W = 0.361 \pm 0.014 \text{ MeV} ,$$

in excellent agreement with the result given above. The somewhat larger uncertainties reflect the fact that Mannhart's evaluation involved only a subset of the ten data sets considered in the present work.

References

[1] F.H. Fröhner, Proc. IAEA Advisory Group Meeting on Nuclear Theory for Fast Neutron Nuclear Data Evaluation, Beijing 1987 (to be published by IAEA)

[2] W. Mannhart, Proc. Meeting on Properties of Neutron Sources, Leningrad 1986, IAEA-TECDOC-410 (1987)

Service de Physique et Techniques Nucléaires
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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

- The dynamics of collective excitation in ^{194}Pt from several scattering experiments.
  J.P. DELAROCHE et al. (2) Phys. Rev. C 36, 73 (1987)

- Impact of the Dispersion relation on the Analyzing Power for neutron elastic scattering from ^{40}Ca.
  J.P. DELAROCHE et al. (1) accepted for publication in Phys. lett. B (1988).

II - Work recently completed

- Energy dependences of the deformed optical potential for neutron scattering from $^{54,56}Fe$ and $^{58,60}Ni$ up to 80 MeV.
  R.S. PEDRONI et al. (1), to be submitted to Phys. Rev. C.

- 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.

- Dispersion relation approach to the Coulomb correction term of the proton nucleus optical model potential.
  J.P. DELAROCHE et al. (1), to be submitted to Phys. Lett. B

- Search for a Fermi energy anomaly in the nucleon scattering potential for deformed nuclei.
  J.P. DELAROCHE, 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 corrections for $n + {}^{184}W$ below 26 MeV.
  J.P. DELAROCHE et al. (3).

REFERENCES

(1) - In collaboration with Duke University, Durham, U.S.A.
(2) - In collaboration with University of Kentucky, lexington, U.S.A.
(3) - In collaboration with Ohio University, Athens, U.S.A.

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FRANCE

NAMES : H. DERRIEN, E. FORT, J.P. GROUILLER, P. LONG, C. ROGER,

I - RECENT PUBLICATIONS AND REPORTS

. 239Pu neutron cross-section evaluation from the KeV region to 20 MeV
E. FORT

II - WORK IN PROGRESS

. Preliminary benchmarking of JEF 1 decay data.
E. FORT, J.P. GROUILLER, C. ROGER

. Reevaluation of 241Pu cross-section in the region up to 1 KeV.
H. DERRIEN

. Reevaluation of 235 U cross-section in the resolved range.
H. DERRIEN

. Evaluation of prompt gamma energy released in fission for important actinides.
E. FORT, J. FREHAUT

. $\bar{\nu}_p$ evaluation for 241Pu in the resolved and unresolved range.
E. FORT, J. FREHAUT, H. TELLIER.

III - WORK PLANNED FOR THE FUTURE

. Contribution to the evaluation of resonance parameters for Ni isotopes.
H. DERRIEN

. 238U evaluation from 5 MeV up to 20 MeV.
E. FORT

. Preliminary benchmark testing of 239Pu.
E. FORT

. $\bar{\nu}_p$ evaluation for 235U.
E. FORT, J. FREHAUT, H. TELLIER

GERMAN DEMOCRATIC REPUBLIC

Names : D. Hermsdorf, H. Kalka, D. Seeliger

Adress: Technische Universität Dresden
Sektion Physik
Mommsenstr. 13
DDR - 8027 Dresden

Work recently completed:

1. Second revised version of evaluated data file for Silicon /1/ (new resonance parameters, improved capture cross sections; now MAT 1402 of BROND)
   (D. Hermsdorf, A.V. Blokhin, A.V. Ignatyuk)

2. First revised version of evaluated data file for Lead /2/ now with resonances parameters, γ-ray-production cross sections and corrected neutron emission spectra in MF 6 MT 10 representation according to /3/; new MAT 8201 of BROND)
   (D. Hermsdorf, A.V. Blokhin, A.V. Ignatyuk)

3. Test of evaluated microscopic data for Si and Pb by integral measurements
   (D. Hermsdorf, M. Toepfer)

4. Phenomenology of angular distributions of neutron emission spectra (DDX) by systematics of experiments and theoretical interpretation
   (D. Hermsdorf, H. Kalka, U. Steininger, J.M. Briseño-Galvez)

Computer codes:

1. Revised version of AMAPRE /4/ improved by an exact treatment of pairing effect according to Fu /5/
   (H. Kalka)

2. Code SIXFIL for processing of MF 6 data structures to produce inelastic scattering matrices for transport calculations
   (M. Toepfer)

Recent publications:

1. D. Hermsdorf,
   Proc. 14th Int. Symp. on Interaction of Fast Neutrons with Nuclei, Gaussig 1984, Report ZfK-562, p. 113, 1985

2. H. Kalka, D. Hermsdorf, D. Seeliger,
   Proc. 3rd Conf. on Neutron Induced Reactions, Smolenice, 1985, in press

3. D. Hermsdorf,
   "Description of File 1402 for Silicon for the Library BROND - Revision of MAT 2015 and Integral Data Tests", INDC(GDR)-38/L, in press

4. D. Hermsdorf,
   "Description of File 8201 for Lead for the Library BROND", INDC(GDR)-39/L, in press

5. D. Hermsdorf, H. Kalka, D. Seeliger, U. Steininger,
   Contributions to "Final Report to CRP on Techniques of Measurements, Analysis and Instrumentation for 14-MeV Neutron Nuclear Cross Sections, Dubrovnik, 1986, in press

Work in progress:

1. Calculation and evaluation of DDX for fast neutron-induced neutron emission for U-238 and Nb-93

2. Revision of MAT 9238 for U-238 for the Library BROND

3. Participation in the CRP on Nuclear Data for Structural Materials

/1/ D. Hermsdorf, Reports INDC(GDR)-20/L, INDC(GDR)-22/L, 1983

/2/ D. Hermsdorf et al., see NNDEN/36, p. 4, 1985

/3/ O. Schwerer, H.D. Lemmel, INDC(NDS)-156, 1984
R.E. Mc Farlane et al., LA-UR-84-1026, Rev. 1, 1984

/4/ H. Kalka, see NNDEN/34, p. 7, 1983

/5/ C.Y. Fu, Nucl. Sci. Engng. 86 (1984) 344

Laboratory:	Technische Universität Dresden, Sektion Physik
Names:	H. Kalka, M. Torjman, D. Seeliger
Activity:	Calculation of DDX of secondary neutrons from neutron-induced reactions on ^{93}Nb in the framework of an exciton-phonon model (code EXIFON) as well as of a phenomenological description
Results:	Consistent description of multi-step compound and direct contributions including collective excitations in a broad incidence-energy range. Contribution to the BROND evaluation in ENDF/B format.
Publications:	H. Kalka et al., Int. Conf. on Neutron Physics, Kiev, 1987 H. Kalka et al., submitted to Z. Phys. A M. Torjman et al., IAEA AGM on Nuclear Theory for Fast Neutron Nuclear Data Evaluation, Peking, 1987
Work in progress:	Systematics of direct contributions in neutron-induced reactions between 5 and 27 MeV incidence energy for mass region $A \gtrsim 40$
Address:	Technische Universität Dresden Sektion Physik Mommsenstrasse 13 DDR - 8027 Dresden, GDR

Laboratory:	Technische Universität Dresden, Sektion Physik
Names:	H. Märten, A. Ruben, D. Seeliger
Activity:	Calculation of prompt-fission-neutron
Results:	Energy and angular distributions of prompt fission neutrons on the framework of the generalized Madland-Nix model in conjunction with a scission point model with semi-empirical, temperature-dependent shell effects for the description of fission energetics as a function of mass asymmetry.
Publications:	H. Märten, D. Seeliger, Nucl. Sci. Eng. 93 (1986) 370 H. Märten et al., Int. Conf. on Neutron Physics, Kiev, 1987 H. Märten et al., Proc. Int. Conf. on Nucl. Phys., Gaussig, 1986, ZfK-610 (1987)
Work in progress:	Systematics of fission neutron spectra, fission neutron yields, and fission fragment energies in the Th-Cf region for incidence-neutron energies below 20 MeV (in connection with STAPRE code calculations).
Address:	Technische Universität Dresden Sektion Physik Mommsenstrasse 13 DDR - 8027 Dresden, GDR

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Indira Gandhi Centre for Atomic Research,
Kalpakkam - 603 102,
Tamil Nadu, INDIA.

Work Recently Completed:

- Integral validation study in the fission sources energy range by analysis of U-233 metal spherical assembly, JEZEBEL-23.

- Analysis of U-233 foil irradiation experiment in the experimental fast reactor, RAPSODIE.

- The code ABAREX of late Prof. Peter Moldauer was successfully commissioned and calculations of all neutron cross sections based on optical-statistical model for U-238 and Th-232 in 20 keV to 10 MeV energy region were made. Several sensitivity calculations are being performed to throw light on the dependence of the calculated cross sections on nuclear model parameters such as the optical model parameters, level density prescriptions, width fluctation correction factors, gamma ray strength functions and transmission factors for fission channels.

- The nuclear data processing code system of IGCAR, Kalpakkam, namely, REX1, REX2 and REX3 have been significantly improved.

Work in Progress:

- Further data testing calculations for Th-232 using CFRMF assembly.

- Continuing evaluation and computation of benchmarks for the testing of Th-232 and U-233 data.

- Improving and completing the Indian evaluated data files for Th-232 and U-233 and to make these files available to IAEA Member States.

- Calculations of displacement damage cross sections using SPECTER code system starting from ENDF/B file.

- Nuclear data services to other Departments and laboratories in the country.

Publications:

1. S. Ganesan et al., (1987) "Verification of the Accuracy of Doppler Broadened Self-shielded Multigroup Cross Sections for Fast Power Reactor Applications" - Under Preparation.

2. S. Ganesan et al.,"Development of Indian Cross section Data Files For Th-232 and U-233", Annual Progress Report of IAEA Co-ordinated Research Programme on Validation and Benchmark Testing of Actinide Nuclear Data (January 1987).

3. V. Gopalakrishnan and S. Ganesan (1987), Updated Version of "A Note on the Program REX1-87 for Accurate Generation of Infinite Dilution Cross Sections, Elastic and Inelastic Transfer Matrices for Fast Reactor Applications", REDG/RP-243(1983)

4. V. Gopalakrishnan and S. Ganesan (1987), Updated Version of "A Note on the Program REX2-87 for Accurate Generation of Infinite Dilution Cross Sections and Self Shielding Factors in Resolved Resonance Region for Fast Reactor Applications", REDG/RP-248 (1984)

5. V. Gopalakrishnan and S. Ganesan (1987), Updated Version of "A Note on the Program REX3-87 for Generation of Self Shielding Factors in Unresolved Resonance Region for Fast Reactor Applications", Updated module of RAMBHA code system referred in IAEA (IND)-30 (1981)

6. S. Ganesan, "A Glimpse of the Requirements of Neutron Induced Cross Section Data Bases for Development of Present and Advanced Systems of Nuclear Energy with Emphasis on Indian Fast Reactor Programme", Invited talk delivered at Indian Institute of Science, Bangalore in the First Indian National CODATA Seminar during Dec 4-6, 1986.

7. S. Ganesan, "Neutron Cross Sections for U-233: (a) Processing and Intercomparison of JENDL-2, ENDF/B-IV and ENDL-84 Basic Evaluated Data Files (b) Integral Validation Study in the Fission Source Energy Range by Analyses of U-233 Spherical JEZEBEL Assembly (c) The analyses of U-233 Irradiation Experiment in RAPSODIE Experimental Fast Reactor", Release Date: 1st August, 1987.

E.N.E.A. - Centro Ricerche Energia "E. Clementel"
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tel. 051/498111 - telex 511578 ENEABO I

Names: F. Fabbri, G. Maino, E. Menapace, A. Mengoni, G.C. Panini, M. Pescarini, G. Reffo, M. Rosetti.

PUBLICATIONS

1. F. Fabbri, G. Maino, E. Menapace and A. Mengoni, "Recent Advances in Nuclear Structure Studies related to Neutron and Photon Processes", in Proceed. of IAEA Advisory Group Meeting on Nuclear Theory in Fast Neutron Nuclear Data Evaluation, Beijing, October 12-16, 1987.

2. G.C. Panini, M. Pescarini: Preliminary validation of the MILER code for interfacing JEF-1 data processed by THEMIS with SCALE system. CFSM/P(87)54.

3. G.C. Panini, F. Siciliano, A. Lioi: The generation, validation and testing of a compled 219-group neutron 36-group gamma-ray AMPX-II library. RIT/COMB/87/11.

Work in progress or recently completed

I) Evaluation of microscopic data through model calculations.

Within the framework of the statistical Hauser-Feshbach formalism with inclusion of parity effects in the nuclear level density, calculations of both discrete and continuum gamma-ray production cross sections, following neutron-induced reactions in the energy range between 1 MeV and 15 MeV, have been performed for stable iron isotopes. Comparison with experimental data is presently in progress.

II) Activity in Nuclear Data Management Processing and Validation

The MILER code for translating multigroup neutron and gamma data from NJOY/THEMIS output to AMPX-II Master Library Interface, has been completed. The IBM version checking is fully satisfactory, while some problems have been met with the CRAY version because of an unusual feature of the AMPX-II library.
Work is in progress to check CALENDF results and to merge them with the THEMIS data in order to produce a group library for the ECCO code (Cooperation with U. Broccoli and P. Peerani) - ENEA Department for Fast Reactors.

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1. Recent publications and reports

[1] Shi Xianjun, H. Gruppelaar, J.M. Akkermans, Effect of angular-momentum conservation in unified-pre-equilibrium and equilibrium raction models, Nucl. Phys. A466 (1987) p. 347.
[2] J. Kopecky, H. Gruppelaar, Systematics of neutron-induced isomeric cross-sections at 14.5 MeV, ECN-200 (1987).
[3] H. Gruppelaar and J.M. Akkermans, Recent developments in exciton and unified models, invited paper IAEA Advisory Group Meeting on Nuclear Theory for Fast Neutron Nuclear Data Evaluation, 12-16 October 1987. Beijing, ECN-87-150.
[4] H. Grupelaar, H.A.J. van der Kamp, J. Kopecky and D. Nierop, The REAC-ECN-2 data library with activation and transmutation cross-sections for use in fusion reactor technology, ECN-87-161.
[5] H. Gruppelaar and J. Kopecky, Systematics of isomer ratios for neutron-induced activation reactions at 14.5 MeV, IAEA Advisory Group Meeting on Nuclear Theory for Fast Neutron Nuclear Data Evaluations, 12-16 October 1987, Beijing (ECN-87-149).
[6] J.M. Akkermans and H. Gruppelaar, The pre-equilibrium master equation with angular momentum conservation and its microscopic aspects, NEANDC Specialists' Mtg. on Pre-equilibrium Nuclear Reactions, Semmering, 10-12 February 1988.

2. Work recently completed

See above-mentioned publications and reports.

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 [2,4,5].

4. Work planned for the future

- Update 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 [3,6].

5. Work on nuclear model codes

See Refs. [1,3,6].

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R. A. Forrest, M. C. Moxon, B. H. Patrick and M. G. Sowerby

Recent Publications and Reports

"The activation cross-section library UKACT1 and the inventory code FISPACT"
R. A. Forrest
IAEA Specialists' Meeting on the International Nuclear Data Library for Fusion Reactor Technology, Vienna, Nov. 1987

Work Recently Completed

(1) Phase 1 review of ENDF/B-VI standards

(2) The activation cross-section library UKACT1 and the decay data library UKDECAY1 for use with the fusion activation inventory code FISPACT. FISPACT is based on the calculational methods of FISPIN but has modified input and output routines.

Work in Progress

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

(2) Calculation of fusion activation using FISPACT and use of sensitivity version of the code to identify the cross-sections and other data which need improvement. An evaluation programme to produce the necessary data will then be carried out.

M. G. Sowerby

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P.E. HODGSON

I. Recent Publications

1. Pre-Equilibrium Processes in Nuclear Reaction Theory. By H. Gruppelaar, P. Nagel and P.E. Hodgson. La Rivista del Nuovo Cimento **9**.1.1986.
2. Weisskopf-Ewing Calculations: neutron-induced reactions. By S. Ait-Tahar and P.E. Hodgson. J. Phys. **G13**.945.1987.
3. Compound Nucleus Reactions. By P.E. Hodgson. Rep. Prog. Phys. **50**.1171. 1987.
4. Multistep Processes in Nuclear Reactions. By P.E. Hodgson. Proceedings of the Symposium on Nuclear Physics. Andhra University, Waltair. December 27–31 1986 p.345.
5. The Systematics of (n,p) cross-sections for 14 MeV neutrons. By S. Ait-Tahar. J. Phys. **G13**.L121.1987.

II. Work Recently Completed

1. Neutron Elastic Scattering. By P.E. Hodgson

A review paper on 'The Neutron Optical Potential' was presented to the International Atomic Energy Agency Advisory Group Meeting on "Nuclear Theory for Fast Neutron Nuclear Data Evaluation" at the Institute of Atomic Energy, Beijing, China, 12–16 October 1987.

Abstract:

The present status of optical model calculations of neutron scattering and interactions is reviewed, with special emphasis on more recent developments and the more promising lines of research. The use of dispersion relations to provide an extra constraint on the potential is discussed, together with their application to studies of the Fermi surface anomaly. The application of potential inversion techniques to determine the form of the potential is also considered.

2. Neutron Inelastic Scattering. By A.M. Street

Neutron inelastic scattering cross-sections are an important part of the input data for reactor calculations for reactors of the breeder type. These cross-sections are often difficult to measure accurately and so there is a need for reliable predictions over a wide range of energies. We have developed a fast and reasonably accurate method for calculations of this type using a normalised 'compound plus direct' interaction approach. We find that the optical potentials input to these calculations, derived from phenomenological fitting, typically have errors of the order of 20% of the partial cross-section. In order to reduce the errors in form and magnitude of these optical potentials we use microscopic theory which allows us to better control the fitting procedures and obtain more accurate forms for the optical potential. By improving the microscopic theory to include 3-body terms we further enhance this process. The overall effect is to produce more accurate and reliable reaction cross-sections.

This work has now been published as a D.Phil thesis (Oxford, 1987).

3. Neutron Scattering and Reactions on ^{93}Nb from 1 to 20 MeV. By D. Wilmore and P.E. Hodgson

This paper has now been accepted for publication in Journal of Physics G.

Abstract:

The cross-sections of all the more important reactions of neutrons on ^{93}Nb are calculated and the results compared with the experimental data. The optical model is used to obtain the differential elastic scattering cross-section and the Weisskopf-Ewing, Hauser-Feshbach and Feshbach-Kerman-Koonin theories are used for the compound and statistical multistep compound contributions to the neutron and proton emission cross-sections. Several other reaction channels, in particular the $(n,2n)$, (n,p) and (n,α), are also studied using one or more of these theories.

4. Multistep Compound Processes in Nuclear Reactions. By P.E. Hodgson

Invited paper presented at the International Atomic Energy Agency Advisory Group Meeting on "Nuclear Theory for Fast Neutron Nuclear Data Evaluation" at the Institute of Atomic Energy, Beijing, China, 12–16 October 1987.

Abstract:

The quantum-mechanical theory of multistep compound reactions due to Feshbach, Kerman and Koonin is reviewed and applied to the analysis of reactions of neutrons with ^{59}Co, ^{93}Nb and ^{209}Bi. A detailed study is made of reactions at 14 MeV, and in addition the total cross-sections in several reaction channels are presented in the range 10–20 MeV. Conclusions are drawn concerning the energy variations of the contributions of direct, pre-equilibrium and compound nucleus reactions.

Work in Progress

1. Multistep Analysis of Neutron Reactions on ^{59}Co and ^{93}Nb (R. Bonetti, P.E. Hodgson, G.M. Field and M. Chadwick)

The quantum-mechanical statistical multistep compound emission (SMCE) theory of Feshbach, Kerman and Koonin is being applied to analyse the reactions of 14 MeV neutrons on ^{59}Co, ^{93}Nb and ^{209}Bi. Calculations carried out in the framework of the SMCE model formalism were found to give a fair account of both the neutron and proton emission data above the $(n,2n)$ and (n,np) thresholds. The SMCE theory was then improved by a reformulation of the original model. The revised model was confined explicitly to a description of particle-hole bound states and included the finite depth of the potential well. Subsequent calculations improved the pre-equilibrium emission predictions compared with the earlier model. Contributions from the multiparticle emission processes were evaluated with the Weisskopf-Ewing theory, using the SMCE results as input for the second stage calculations. Considered together with the results of a statistical multistep direct emission (SMDE) calculation of the (n,n') reaction on ^{59}Co at 14 MeV, the multistep theory was seen to provide a good fit to the emission data at both the forward and backward angles. The revised model was then used to predict the variation of SMCE with excitation energy and compound-state mass number. The energy dependence was seen to reflect the changing proportions of compound nucleus and pre-equilibrium processes. From a consideration of the model formalism the mass dependence of pre-equilibrium SMCE was derived. Values for the effective interaction strength deduced from these calculations were found to be rather constant over the entire energy and mass ranges.

Some of this work has been published as the D.Phil thesis (Oxford, 1987) of G.M. Field.

2. Statistical Theory Calculations (M. Chadwick)

The Weisskopf-Ewing statistical theory of nuclear reactions has been used to investigate the energy dependence of neutron induced reactions on medium atomic mass nuclei. In particular the (n, α) reaction was studied, and it was found that if individual final nuclear states were taken into account using the Hauser Feshbach formalism, good agreement with data was obtained.

The statistical multistep compound theory of Feshbach, Kerman and Koonin has been used to calculate n and p emission cross sections for the $n + {}^{59}Co$ reaction. At a neutron incident energy of 14 MeV, where the multistep-direct contribution is small, good agreement with experiment was found. Alpha emission will be incorporated into the multistep compound code to determine the importance of pre-equilibrium emission of alpha particles.

IV. Work on Nuclear Model Codes

1. The Intercomparison of Nuclear Model Computer Codes (P.E. Hodgson)

Invited paper presented to the International Atomic Energy Agency Advisory Group Meeting on "Nuclear Theory for Fast Neutron Data Evaluation" at the Institute of Atomic Energy, Beijing, China, 12–16 October 1987.

Abstract:

The present state of the programme of intercomparison of nuclear model computer codes, organised under the auspices of the Nuclar Data Bank in Paris, is reviewed. The different types of intercomparison are described, and the general principles underlying the intercomparison are critically discussed.

V. Other Subjects of Interest

1. Nuclear Momentum Distributions and Correlations in Nuclei. By A.N. Antonov, P.E. Hodgson and I.Zh. Petkov. Proceedings of the 3rd Workshop on Perspectives of Nuclear Physics at Intermediate Energies, Trieste, 18–22 May, 1987.
2. Superdeformed Nuclei. By P.E. Hodgson. Contemporary Physics. **28**.365.1987.
3. A Study of Short-Range Correlation Effects on Nuclear Spatial and Momentum Distribution. By A. Malecki, A.N. Antonov, I.Zh. Petkov and P.E. Hodgson. Z. Phys. **A328**.393.1987.
4. Natural Orbital Calculations of Nuclear Momentum Distributions. By A.N. Antonov, I.Zh. Petkov and P.E. Hodgson. Nuovo Cimento. **97A**.117.1987.

P.E. Hodgson
February 1988

WINFRITH ATOMIC ENERGY ESTABLISHMENT

United Kingdom Atomic Energy Authority
Dorchester, Dorset

1. DECAY DATA AND FISSION YIELD EVALUATION

(A) Heavy Elements (A L Nichols (AEEW))

There have been no evaluations made specifically for the UKCNDC data files during this period. Efforts have been directed towards evaluation problems identified with the 4n decay chain of ^{232}U, and the aim is to complete this work by mid-1988.

(b) Activation Products (A L Nichols and P Robb (AEEW))

Decay data for ^{51}Cr, ^{65}Zn and ^{198}Au have been re-evaluated on the basis of critical discussions at a Rome meeting of the IAEA-CRP on X- and Gamma-ray Standards for Detector Calibration, 11-13 June 1987 (INDC(NDS)-196/GE). Further efforts are required to re-evaluate the gamma ray emission probability data for ^{75}Se and $^{243}Am/^{239}Np$ to assist in this exercise.

(c) Fission Yields (M F James (AEEW) and D R Weaver (University of Birmingham))

The fission yield library UKFY1 is now available in ENDF/B5 format. It consists of three separate files: UKIFYU1, containing independent yields that are the result of a thorough evaluation but which have not been adjusted to fit physical constraints; UKIFYA1, containing independent yields obtained by adjusting the data in the former library by least-squares to fit several physical constraints; and UKCFYA1, containing cumulative yields corresponding to UKIFYA1. These have been compared with USA, French and Chinese libraries in a paper presented at the Specialists' Meeting on Data for Decay Heat Predictions at Studsvik in September 1987.

A further revision of the UK library is now underway. This will concentrate on bringing the database up-to-date, and re-evaluating fractional independent yields. The former task will be made much easier by the agreement at Studsvik that the international data format EXFOR should be the internationally-used format for data bases of measured fission yields.

2. RESONANCE PARAMETER EVALUATIONS (R W SMITH)

Work in progress includes :

(a) An analysis - using the programs DEEBAR for the analysis of resonance spacings and LJPROB for the analysis of the width distributions - of the provisional assignments of widths and spins of the ^{238}U resonance parameters (up to $\sim$ 14 Kev) derived at AERE Harwell from the measurements made at ORNL.

(b) A new evaluation of the resonance parameters for the isotopes of Hafnium (presently in JEF-1) for inclusion in JEF-2.

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I. Recent Publications and Reports

J.W. MEADOWS, D.L. SMITH, M.M. BRETSCHER AND S.A. COX
Measurement of 14.7-MeV Neutron Activation Cross Sections for Fusion
Annals of Nuclear Energy 14 489 (1987).

D.L. SMITH
On the Relationship Between Micro and Macro Correlations in Nuclear Measurement Uncertainties
Nuclear Instruments and Methods A257, 365 (1987).

D.L. SMITH
Generation of the Covariance Matrix for a Set of Nuclear Data Produced by Collapsing a Larger Parent Set Through the Weighted Averaging of Equivalent Data Points
Nuclear Instruments and Methods A257, 361 (1987).

J.W. MEADOWS
The Fission Cross Section Ratios And Error Analysis For Ten Thorium, Uranium, Neptunium and Plutonium Isotopes at 14.74 MeV Neutron Energy
ANL/NDM-98 (1987).

D.L. SMITH
Some Comments on the Effects of Long-Range Correlations in Covariance Matrices for Nuclear Data
ANL/NDM-99 (1987).

M. SUGIMOTO, A.B. SMITH and P.T. GUENTHER
Ratio of the Prompt-Neutron Spectrum of Plutonium 239 to that of Uranium 235
Nuclear Science and Engineering, 97 235 (1987).

J.W. MEADOWS, D.L. SMITH AND R.D. LAWSON
Differential Measurements and an Evaluation of the Co-59(n,alpha)Mn-56 Reaction Cross Section
Annals of Nuclear Energy 14 603 (1987).

Y. WATANABE, J.W. MEADOWS AND D.L. SMITH
An Integral Test of Several Fission Cross Sections in the Neutron Spectrum Produced by 7-MeV Deuterons on a Thick Be-Metal Target
Annals of Nuclear Energy, 14 563 (1987).

D.L. SMITH, J.W. MEADOWS, P.T. GUENTHER AND L.R. GREENWOOD
Development of the Be(d,n) Neutron Source for Cross-Section Investigations in the Few-MeV Energy Range
6th ASTM-EURATOM Symposium on Reactor Dosimetry, Jackson Hole, Wyoming, 31 May - 5 June 1987.

D.L. SMITH
Activity Uncertainty Specification
6th ASTM-EURATOM Symposium on Reactor Dosimetry, Jackson Hole, Wyoming, 31 May - 5 June 1987.

R.D. LAWSON, P.T. GUENTHER AND A.B. SMITH
The Energy Dependence of the Optical-Model Potential for Fast-Neutron Scattering from Bismuth
Phys. Rev. C, Vol. 36, No. 4 (1987).

A. SMITH, P. GUENTHER AND R.D. LAWSON
Cobalt, Fast Neutrons and Physical Models
Bull. Am. Phys. Soc. 32, No. 4, p. 1048 (1987).

A.B. SMITH, P.T. GUENTHER AND R.D. LAWSON
The Energy Dependence of the Optical-Model Potential for Fast-Neutron Scattering From Bismuth
ANL/NDM-100 (1987).

A.B. SMITH, P.T. GUENTHER, J.F. WHALEN AND R.D. LAWSON
Cobalt, Fast Neutrons and Physical Models
ANL/NDM-101 (1987).

D.L. SMITH
Investigation of the Influence of the Neutron Spectrum in Determinations of Integral Neutron Cross-Section Ratios
ANL/NDM-102 (1987).

A.B. SMITH, P.T. GUENTHER and R.D. LAWSON
Energy Dependence of the Optical Model Potential for Fast Neutron Scattering from Cobalt
Submitted to Nuclear Physics A.

II. Work Recently Completed (see above publication list)

III. Evaluation Work in Progress

A. Comprehensive evaluated file for Vanadium: Nearing completion. Resonance parameters, cross sections and angular distributions finished. File-6 and uncertainty specification remains to be done.

B. Comprehensive evaluated file for Cobalt: Nearing completion. Cross sections, angular distributions, evaporation spectra, and uncertainty specification finished. File-6 and resonance parameters remain to be done.

C. Comprehensive evaluated file for Bismuth: Nearing completion. File-6, resonance parameters, and uncertainty specification remain to be done.

D. Evaluated file for ^{238}U extending from the inelastic threshold to 20.0 MeV: Work has started and some portions are done.

E. Evaluated file for Zirconium: Data base is assembled and evaluation is starting.

F. Evaluated total and scattering cross sections of beryllium: Total cross section is nearing completion and scattering data has been assembled.

G. Evaluation of ^{58}Ni: Work has started extending from ≈ 650 keV to 20.0 MeV. Models are being developed.

H. Prior Yttrium evaluation has been corrected for minor clerical errors and resubmitted.

I. Minor errors in the prior Niobium evaluation are being corrected. Also the $^{93}Nb(n,n')^{93m}Nb$ dosimetry cross section is being redone in the light of new experimental information.

Numerical values corresponding to any of the above work are available, including both preliminary and final results.

IV. Some Future Work

A. Completion of above efforts.

B. Comprehensive study of uncertainty formalisms.

V. Physical Studies and Model Codes

Continuing attention is being given to the physical basis of the optical-statistical model. Current attention is focused on the structural materials, particularly vanadium and cobalt. Work has also started with ^{58}Ni. Less advanced are a wide range of similar model studies throughout the periodic table. Continual improvements are made in the spherical optical model code ABAREX, particularly with respect to its use in experimental interpretation. The latest formulation of Raynal's code ECIS has been implemented. The codes CADE and ALICE are operational, and GNASH is being implemented on the new ANL Cray. The codes are extensively used in experimental interpretation and evaluation, but the emphasis remains on experimentally-observed quantities.

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I. Recent Publications and Reports

BNL-40158 Aug. 1987
"Comparative Studies in Direct Slow-Neutron Capture Calculations"
S. F. Mughabghab, Brookhaven National Laboratory

BNL-NCS-40157 Aug. 1987
"Spin-Spin and Isospin Interactions with Capture Measurements,"
S. F. Mughabghab, Brookhaven National Laboratory

Nuclear Safeguards Technology 1986
Proceedings of an International Symposium on Nuclear Material Safeguards
IAEA; Vienna 10-14 November 1986, 2 329 (1987)
"Neutron Multiplicity for Neutron Induced Fission of ^{235}U, ^{238}U and ^{239}Pu as a Function of Neutron Energy,"
M. S. Zucker and N. E. Holden, Brookhaven National Laboratory

BNL-NCS-51771 First Edition, Supplement Three April 1978
"Integral Charged Particle Nuclear Data Bibliography,"
N. E. Holden, S. Ramavataram and C. L. Dunford
Brookhaven National Laboratory

BNL-NCS-40070, DOE/NDC-45 May 1987
"Summary of the Meeting of the Medium Energy Nuclear Data Working Group,"
S. Pearlstein, Brookhaven National Laboratory

II. Work in Progress or Recently Completed

1. Neutron Data Atlas.

   The fourth edition of Neutron Cross Sections; Volume 2, Book of Curves is in press and should be issued by Academic Press in the Spring. The experimental data have been plotted with the evaluated curves taken from ENDF/B-V where they exist. The price is expected to be about US $65 for hard bound and US $40 for soft bound editions.

11. E.D. Arthur, M. Bozoian, D.G. Madland, R.T. Perry, W.B. Wilson, and P.G. Young, "Application of Nuclear Models to the Calculation of 20-100 MeV Neutron-Induced Reaction Data," presented at IAEA Advisory Group Meeting on Nuclear Theory for Fast Neutron Data Evaluation, Beijing, Peoples Republic of China, 12-16 October 1987.

12. M.C. Brady and T.R. England, "Few Group Representation of the Energy Spectra of Delayed Neutrons," Tran. Am. Nuc. Soc. V54, p. 342 (June 1987).

13. T.R. England, M.C. Brady, E.D. Arthur, R.J. LaBauve, and F.M. Mann, "Evaluated Delayed Neutron Precursor Data," Trans. Am. Nucl. Soc. V54, p. 350 (June 1987).

14. 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, "^{7}Be(n,p)^{7}Li Total Cross Section from 25 MeV to 13.5 keV," submitted to Phys. Rev. C (1987).

II. Work Recently Completed

1. Completed R-matrix analyses of the ^{7}Li and ^{11}B system and participated in combination procedure for ENDF/B-VI standard cross sections.

2. Completed preliminary evaluations of neutron-induced data to 100 MeV for ^{1}H, ^{12}C, ^{16}O, ^{27}Al ^{28}Si, ^{40}Ca, and ^{56}Fe using ENDF/B-VI format.

3. Completed preliminary 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.

4. Completed preliminary evaluations of proton-induced data to 50 MeV for Fe, Ni, Cu, and W, and to 100 MeV for C and Al.

5. Completed development of a new model of the average neutron and proton pairing gaps.

6. Completed analysis of neutron reactions on ^{64,66,68}Zn.

III. Work in Progress

1. Finalization of evaluations of ^{11}B, ^{151}Eu, ^{153}Eu, ^{165}Ho, ^{169}Tm systems.

2. Theoretical analyses of neutron reactions with ^{235}U.

3. Covariance analysis of n+^{7}Li data for ENDF/B-VI.

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

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

6. Fission product yield evaluations.

7. Calculation and evaluation of additional proton-induced data libraries to 100 MeV.

IV. Work Planned for the Future

1. Extension of deformed rare-earth and actinide optical potentials to $E_n = 30\text{-}40$ MeV.

2. Data evaluations of ^{14}N, ^{16}O, ^{27}Al, $^{185,187}Re$.

3. Improvement of ^{235}U and ^{239}Pu evaluations for ENDF/B-VI.

4. Improve beta and gamma spectra for fission products.

5. Expand fission product yield data to include additional actinides and continue updating basic data libraries.

V. Work on Nuclear Model Codes

1. New version of the full Hauser-Feshbach version of GNASH has been prepared for export. This version includes the Ignaytuk level density formulation as an option, with full matching to the discrete level region.

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Compiler: D. C. Larson

1. Recent publications and reports

H. Derrien, G. de Saussure, L. C. Leal, R. B. Perez, and N. M. Larson, "R-Matrix Analyses of the ^{235}U and ^{239}Pu Neutron Cross Sections," International Conference on Nuclear Data for Science and Technology, Mito, Japan, May 30--June 3, 1988.

D. M. Hetrick, C. Y. Fu, and D. C. Larson, "Calculated Neutron-Induced Cross Sections for ^{52}Cr from 1 to 20 MeV and Comparisons," ORNL/TM-10417 (September 1987).

N. M. Larson and F. G. Perey, "Resonance Parameter Analysis with SAMMY," International Conference on Nuclear Data for Science and Technology, Mito, Japan, May 30--June 3, 1988.

R. W. Peelle and H. Conde, "Neutron Standard Reference Data," International Conference on Nuclear Data for Science and Technology, Mito, Japan, May 30--June 3, 1988.

K. Shibata and D. M. Hetrick, "Calculated Neutron-Induced Cross Sections for ^{53}Cr from 1 to 20 MeV," ORNL/TM-10381 (May 1987).

D. M. Hetrick, C. Y. Fu, and D. C. Larson, "Calculated Neutron-Induced Cross Sections for $^{58,60}Ni$ from 1 to 20 MeV and Comparisons with Experiments," ORNL/TM-10219 (June 1987).

L. W. Weston and E. D. Arthur, "Evaluation of the Neutron Cross Sections for Pu-240," ORNL/TM-10386 (ENDF-343) (April 1987).

L. C. Leal, G. de Saussure, and R. B. Perez, "R-Matrix Analysis of the ^{235}U Neutron Cross Sections," 1988 Summer American Nuclear Society Meeting, San Diego, CA, June 12-16, 1988.

C. Y. Fu, "A Simplified Unified Hauser-Feshbach/Pre-Equilibrium Model for Calculating Double Differential Cross Sections," NEANDC Specialists' Meeting on Pre-Equilibrium Reactions, Semmering, Austria, February 10-12, 1988.

C. Y. Fu, "Approximation of Precompound Effects in Hauser-Feshbach Codes for Calculating Double Differential (n,xn) Cross Sections," Nucl. Sci. Eng. (Submitted November 1987).

D. C. Larson and C. Y. Fu, "Description of Evaluation of ^{nat}Pb Performed for ENDF/B-VI," IAEA Specialists' Meeting on the International Nuclear Data Library for Fusion Reactor Technology, Vienna, Austria, November 16-18, 1987.

D. C. Larson, C. Y. Fu, and D. M. Hetrick, "Description of Evaluation for ^{54,56,57,58}Fe Performed for ENDF/B-VI," IAEA Specialists' Meeting on the International Nuclear Data Library for Fusion Reactor Technology, Vienna, Austria, November 16-18, 1987.

D. C. Larson, C. Y. Fu, and D. M. Hetrick, "Some Notes on the Calculation of Energy-Angle Correlated Distributions with TNG and Their Representation in File 6 Formats," IAEA Specialists' Meeting on the International Nuclear Data Library for Fusion Reactor Technology, Vienna, Austria, November 16-18, 1987.

D. C. Larson, D. M. Hetrick, and C. Y. Fu, "Description of Evaluation for ^{63,65}Cu for ENDF/B-VI," IAEA Specialists' Meeting on the International Nuclear Data Library for Fusion Reactor Technology, Vienna, Austria, November 16-18, 1987.

D. C. Larson, D. M. Hetrick, and C. Y. Fu, "Description of Evaluation for ^{50,52,53,54}Cr Performed for ENDF/B-VI," IAEA Specialists' Meeting on the International Nuclear Data Library for Fusion Reactor Technology, Vienna, Austria, November 16-18, 1987.

D. C. Larson, D. M. Hetrick, and C. Y. Fu, "Description of Evaluation for ^{58,60,61,62,64}Ni Performed for ENDF/B-VI," IAEA Specialists' Meeting on the International Nuclear Data Library for Fusion Reactor Technology, Vienna, Austria, November 16-18, 1987.

2. Work recently completed

a. A comprehensive analysis of ^{58}Ni transmission, capture and differential elastic scattering data in the resonance region completed last year was put on hold while work to understand difficulties with capture measurements of the 1.15 keV resonance in ^{56}Fe was undertaken. This work on ^{56}Fe is showing progress and has given a better understanding of capture measurement problems in general. As a consequence, analysis of the ^{58}Ni data was resumed, and the ^{58}Ni paper will be finished and submitted.

b. A measurement of the ^{51}V(n,Xγ) measurement was completed for E_n=100 keV to 40 MeV, using a Ge detector and the 20-m flight path at ORELA. This measurement is part of a series to provide high-resolution gamma-ray production cross sections for structural materials over a wide incident neutron energy range.

c. A measurement of the transmission through several samples of ^{238}U was completed, using the 200-m flight path at ORELA. A new two-phototube NE110 detector was developed which can be biased below the single photoelectron level for each tube, and measure neutron energies to less than 1 keV. This, along with a detailed study of the resolution function associated with the ORELA target, will provide significantly improved data and allow the resolved resonance energy range to be extended to 15 keV or higher.

d. A measurement of the differential elastic scattering cross section for ^{56}Fe has been completed. The 200-m flight path at ORELA was used, and six detectors in the 1.8-m scattering chamber were used to obtain data at scattering angles of 39°,55°,90°,120°,140° and 160° from 15-1000 keV. The data are being used in a simultaneous analysis of total, capture and scattering data for the resonance region of ^{56}Fe.

e. A measurement of the $^{59}Co(n,X\gamma)$ reaction was completed from E_n=100 keV to 40 MeV, using a Ge detector and the 20-m flight path at ORELA. The associated flux measurement has also been completed, and the data will be reduced to cross sections.

f. A high resolution capture measurement on ^{238}U has been completed from 1 to 100 keV, using the 150-m flight path at ORELA. Three separate sample thicknesses were used, and the data are presently being analyzed.

g. The code O5S, used for neutron scintillation-detector calibration and efficiency, has been completely rewritten, including updated cross section values for the various reactions occurring in the detector, adding cross sections for reactions which become important for neutron energies up to 50 MeV, implementing light tables which provide a consistent representation of available data for the various outgoing particles and improving reaction calculations to be more physically realistic. The new code has been named SCINFUL, and has been extensively tested against response function data available in the literature.

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. Completion of the data taking is expected early this summer.

b. Isotopic evaluations for $^{58,60,61,62,64}Ni$ are nearly complete and will be 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. Special attention is being paid to insure energy balance. The new File 6 formats are being used extensively to include energy-angle correlations and recoil spectra.

The new Reich-Moore formats are being used for the resonance parameters, based on recent ORELA data.

c. The status of the $^{50,52,53,54}Cr$ evaluations is similar to the Ni work described above. Evaluations for the minor isotopes $^{50,54}Cr$ are included as for nickel. Resonance parameters are taken from recent CBNM work at Geel.

d. The status of the $^{54,56,57,58}Fe$ evaluations is also similar to the Ni work described above. Evaluations for the minor isotopes $^{54,58}Fe$ are included as for nickel. Resonance parameters will be taken from the analysis of the recent high resolution transmission and scattering data from ORELA, as well as the ORELA capture data.

e. SAMMY resonance parameter analyses are currently underway for transmission and fission data for ^{235}U and ^{239}Pu. The goal is to extend the resolved resonance region from 83 eV to 2 keV for ^{235}U and from 300 eV to 1 keV for ^{239}Pu for inclusion in ENDF\B-VI. In addition, a similar analysis for 241Pu will extend the resolved resonance region from 100 to 300 eV.

f. The combination process for the standards evaluation whereby the results of the R-matrix and simultaneous evaluations are combined is essentially finished and results are out for world-wide review.

g. A new high resolution measurement of the ^{235}U and ^{239}Pu fission cross sections 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 should remove this problem.

h. A new multicrystal spectrometer, eventually to contain 36 BaF_2 crystals, is under construction. Monte-Carlo tests show an efficiency of >90% for a capture cascade with a multiplicity of 3.5 and sum energy of 6 MeV, with a 400-keV bias.

i. Development work is underway on a system based on NE-213 scintillation detectors to measure neutron and gamma-ray emission cross sections for E_n = 1-20 MeV. Preliminary measurements with one NE213 detector are very encouraging with respect to count rates, backgrounds, etc.

4. Work planned for the future

a. A new measurement of the capture width of the 1.15-keV resonance in ^{56}Fe is planned. Two C_6F_6 detectors will be used at the 20-m flight station. A careful characterization and modeling of the detectors and environs will be used in an electron transport calculation of the response function and efficiency of the detector system. Lack of adequate detailing of the electron transport in and around detectors has been shown to adversely affect previous results of some capture cross sections.

b. More high-resolution scattering measurements in the resonance region from 15 - 1000 keV are planned for samples of ^{54}Fe, ^{52}Cr, and ^{204}Pb.

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

d. Work on the neutron and gamma ray emission cross-section measurement system will continue, with replacement of the data acquisition system being a priority. Measurements on iron will be initiated from 1-20 MeV.

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

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, has been improved in several areas: (1) enhanced peripheral neutron emission resulting naturally from more rigorous angular momentum conservation in the precompound stage, (2) An advanced approximation for odd-A targets using the true target spin for the H-F stage but zero target spin for the precompound stage, (3) An automatic search for parameters of the constant-temperature part of the Gilbert-Cameron composite level density formula to best fit the given discrete levels, (4) A simple approximation (a rigorous approximation is being sought) for collective excitation in the continuum for spherical nuclei such as lead to better fit the experimental neutron emission spectra and double differential cross sections for evaluation purposes, (5) Separation of first and second neutron spectra in the (n,2n) reaction for a better approximation in the calculation of recoil spectra, and (6) separation of gamma-rays arising from discrete levels and from the continuum for best usage of File 6 Sections 51-91 in the new ENDF/B-VI format and for stringent checks on energy balance in Section 91.

b. An IBM version of SAMMY, a R-matrix code using Bayes' equation, has been developed to complement the existing VAX and FPS versions. A detailed resolution function tailored to the ORELA target has been implemented. The ability to output SAMMY results in the appropriate ENDF/B-VI format is being implemented. The SAMMY manual is currently undergoing revision to include new features incorporated the past three years.

EUROPEAN FUSION FILE (EFF)

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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, Inv. paper, IAEA Advisory Group Meeteing on Nuclear Data for Fusion Reactor Technology, Dresden, 1-6 December 1986.
[2] H. Gruppelaar, J.M. Akkermans and D. Nierop, Processing of double-differential continuum emission cross-sections, submitted to Nucl. Sci. Eng. , ECN-87-090 (1987).
[3] H. Gruppelaar, H.A.J. van der Kamp, J. Kopecky and D. Nierop, The REAC-ECN-2 data library with activation and transmutation cross-sections for use in fusion reactor technology, ECN-87-161.

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 [3].

4. Work planned for the future

- Compilation of EFF-2 data library.
- Compilation of a European Activation File (EAF) for fusion technology.
- Cooperation with ITER-project (FENDL).

5. Work on codes

The GROUPXS code for file-handling and multi-group constant calculations of double-differential cross-sections stored in MF6 of ENDF-VI is available from the NEA Data Bank, cf. Ref. [2].

NEA DATA BANK

Address: 91191 Gif-sur-Yvette CEDEX
FRANCE

Joint Evaluated File (JEF)

1. A JEF Working Group Meeting on Evaluation Work for JEF-2 was held on 16th November 1987 at the NEA Data Bank.

   The status of the new evaluations planned for JEF-2 were reviewed. The thermal values for U-235 proposed for the new ENDF/B-VI stan--dards file were extensively discussed and a recommendation from the JEF Group will be discussed at the next meeting (April 1988) and then transmitted to the CSEWG Community.
   The evaluation of the resolved resonance region of U-238, which was almost at a final stage, would extend up to 10 keV and contained at present more than 1500 resonances.Both the new Pu-239 evaluation and the resonance parameters of Pu-241 would most probably be available for testing at the NEA Data Bank before the next meeting.

   The progress in the evaluation of the structural materials and fis--sion products were also reviewed. In most case it seemed that the deadlines could be met and that at least preliminary files would be available at the middle of 1988.

   It was decided that the more important isotopes in JEF-2, such as U-235,-238, Pu-239 and the structural materials would contain both gamma production data and covariance information.

   The cooperation with other evaluation efforts was discussed and a decision on the distribution and exchange policy would be taken at the next meeting of the scientific coordination group.

2. A JEF Working Group Meeting on Benchmark Testing and Processing Codes was held on 17 November 1987 at the NEA Data Bank.

   Recent new activity had been limited in the field of benchmark tes-ting of the JEF-1 file. Results from a few new thermal calculations were presented, but most of the discussion concentrated on the ques-tion of processing codes and group cross section libraries. The NJOY code system had been delayed, but has, at the time of writing, just arrived at the NEA Data Bank. Two new group cross section libraries based on JEF-1 had been produced in Wuerenlingen; one in WIMS and one in VITAMIN-J format. A new computer code,for producing AMPX li-braries with the code NJOY/THEMIS, was under development in Bologna.

Recent publications available at the NEA Data Bank

- Proceedings of the NEACRP/NEANDC Specialists' Meeting on Decay Heat Predictions, Studsvik, Sweden, 7th-10th September 1987 (NEACRP-302'L', NEANDC-245'U')

- Evaluation of neutron nuclear data for CF-252 and BK-250.(T.Nakagawa) JAERI-M 88-004,NEANDC(J) 126/U,INDC(JPN) 112/L

- JEF Report 10 .JEF/EFF based neutron libraries.P. Vontobel,S. Pelloni Wuerenlingen EIR-Bericht-636

- Proceedings of the NEANDC Specialists' Meeting on Preequilibrium Nuclear Reactions. Semmering,Austria, 10-12 February 1988.In press.

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