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Neutron source spectra format (A 29)

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The averaged quantity data compiled in EXFOR have to be supplied by the numerical data of incident particle spectra.

Analysis of data, available in EXFOR, had shown that information about neutron spectra, was practically absent.

The type of spectrum and its characteristics should be include under the information-identifier keyword INC-SPECT

Old	**in free text**
New	**in numeric data type, using special ENTRY or SUBENTRY for neutron spectrum if the spectrum is commonly applied to measurements performed at the neutron source**

Use **special form** of **REACTION** to define the neutron source (see table below) with the proper modifier **SPD** to REACTION **SF8.**

Use **DATA** to enter **the numerical spectral data.**

Data, **that are averaged** over broad incident-projectile energy spectrum and entered into the EXFOR system, **should be labelled** by the keyword **INC-SOURCE** with use of all relevant keywords from the Inc-Source Dictionary (#19) and **the cross-reference** to the EXFOR **entry/subentry** with **these numerical spectral data.**

This **cross-reference** must be coded as an **eight-digit integer.**

The special form of REACTION to define the neutron sources

Name of neutron source	In INC-SPECT (Dictionary #19)	SF1-SF8 in REACTION in Entry/SubEntry with spectrum
Alpha-Beryllium	A-BE	4-BE-9(A,X)0-NN-1,,DE,,SPD
Spont. fission of Cf-252	CF252	98-CF-252(0,F) ,, NU/DE,,SPD
Spont. fission of Cm-244	CM244	96-CM-244(0,F),, NU/DE,,SPD
Spont. fission of Cm-246	CM246	96-CM-246(0,F),, NU/DE,,SPD
Spont. fission of Cm-248	CM248	96-CM-248(0,F),,NU/DE,,SPD
Deuteron-Beryllium	D-BE	4-BE-9(D,X)0-NN-1,,DE,,SPD
Deuteron-Carbon 12	D-C12	6-C-12(D, X)0-NN-1,,DE,,SPD
Deuteron-Carbon 14	D-C14	6-C-14(D, X)0-NN-1,,DE,,SPD
Deuteron-Deuterium	D-D	1-H-2(D,X)0-NN-1,,DE,,SPD
Deuteron-Lithium	D-LI	3-LI-0(D,X)0-NN-1,,DE,,SPD
Deuteron-Lithium 7	D-LI7	3-LI-7(D, X)0-NN-1,,DE,,SPD
Deuteron-Nitrogen 14	D-N14	7-N-14(D, X)0-NN-1,,DE,,SPD

Deuteron-Nitrogen 15	D-N15	7-N-15(D, X)0-NN-1,,DE,,SPD
Deuteron-Tritium	D-T	1-H-3(D,X)0-NN-1,,DE,,SPD
Evaporation neutrons	EVAP	13-Al-27(P,X)0-NN-1,,DE,,SPD 74-W-0(P,X)0-NN-1,,DE,,SPD 82-Pb-0(P,X) 0-NN-1,,DE,,SPD 92-U-0(D,X) 0-NN-1,,DE,,SP
Nuclear explosive device	EXPLO	???
Proton-Beryllium	P-BE	4-BE-9(P, X)0-NN-1,,DE,,SPD
Proton-Deuterium	P-D	1-H-2(P, X)0-NN-1,,DE,,SPD
Photo-neutron	PHOTO	1-H-2(G, X)0-NN-1,,DE,,SPD 13-Al-27(G,X)0-NN-1,,DE,,SPD 74-W-0(G,X)0-NN-1,,DE,,SPD 92-U-0(G,X)0-NN-1,,DE,,SPD
Proton-Lithium 7	P-LI7	3-LI-7(P, X)0-NN-1,,DE,,SPD
Polarized neutron source	POLNS	???
Proton-Tritium	P-T	1-H-3(P, X)0-NN-1,,DE,,SPD
Spont.fission of Pu-240	PU240	94-PU-240(0,F) ,, NU/DE,,SPD
Spont.fission of Pu-242	PU242	94-PU-242(0,F) ,, NU/DE,,SPD
Reactor (NEUT)	REAC	92-U-FUL(X,X) 0-NN-1,,DE,,SPD
Thermal column (NEUT)	THCOL	???

The SF1-SF8 designation of source, marked by “???”, is not defined today.

The advantages would be:

1. to refrain from repeating the neutron spectrum information in Entries with data obtained with that neutron source spectrum.

2. to facilitate data search of neutron source spectrum - they could be found using the modifier SPD in REACTION SF8 and the EXFOR retrieval system; this service is important for experimenters, evaluators and compilers.

3. to use keyword INC-SOURCE for cross-reference to the relevant spectrum - it will allow us to avoid introduction of new Dictionary and essential modification of the checking codes.

To demonstrate an example of such Entries,
let consider subentry 32217003, where the filtered neutron spectrum was used to measure the averaged radiation cross section on Ta.

There were two types of spectrum: calculated and experimental ones, the latter was obtained by differentiation of the instrumental proton recoil spectrum.

We can use **one new entry** (take for example **32**777) for the filtered neutron spectra. In subentry **32**777001, as usual, we describe general information using keywords TITLE, AUTHOR, INSTITUTE, …

ENTRY	32777	20110408				32777	0	1
SUBENT	32777001	20110408				32777	1	1
BIB	7	10				32777	1	2
TITLE	Measurements of neutron capture cross-section for					32777	1	3
	tantalum at the neutron filtered beams					32777	1	4
AUTHOR	(O.Gritzay,V.Libman,A.V.Chyzh,V.F.Razbudey)					32777	1	5
INSTITUTE	(4UKRIJD)					32777	1	6
REFERENCE	(C,2008KYIV,,548,2008) Result on 59 keV was					32777	1	7
	presented at the NPAE-Kyiv2008,ID# 86-95.					32777	1	8
FACILITY	(REAC,4UKRIJD) Reactor WWR-M					32777	1	9
INC-SOURCE	(REAC) Neutron filters installed in horizontal channel					32777	1	10
	of the reactor.					32777	1	11
HISTORY	(20110408) UKRNDC					32777	1	12
ENDBIB	10	0				32777	1	13
NOCOMMON	0	0				32777	1	14
ENDSUBENT	13	0				32777	199999	

For calculated neutron spectrum we can use subentry **32**777**002** and for experimental one the subentry **32**777**003**. Note this neutron spectrum was created by filtering of the reactor spectrum. Since the reactor used uranium fuel, we propose to fill the fields **SF1-SF4** in **REACTION** as **92-U-FUL(X,X)0-NN-1**.

SUBENT	32777002	20110408				32777	2	1
BIB	2	8				32777	2	2
REACTION	(92-U-FUL(X,X)0-NN-1,,DE,,SPD/REL,CALC) Using JENDL-3.3					32777	2	3
					and CENDL-2	32777	2	4
COMMENT	Calculation was done by FILTER.5 using JENDL-3.3 for					32777	2	5
	Ni-58(83.15 g/cm2),V(24.44 g/cm2),Al(5.4 g/cm2),					32777	2	6
	B-10(0.5 g/cm2), and using CENDL-2 for S(147.78 g/cm2)					32777	2	7
	Calculated energy line is 58.9 keV, purity about 99%.					32777	2	8
	The limits of 95% response function for the 59 keV					32777	2	9
	filter spectrum were defined as 52.2 to 60.1 keV.					32777	2	10
ENDBIB	8	0				32777	2	11
NOCOMMON	0	0				32777	2	12
DATA	2	1543				32777	2	13
E	DATA					32777	2	14
EV	ARB-UNITS					32777	2	15
50000.15	7.05730E-11					32777	2	16
50019.84	7.85371E-11					32777	2	17
50039.52	8.42285E-11					32777	2	18

63945.89	6.82944E-26					32777	2	1557
64018.24	7.01394E-26					32777	2	1558
ENDDATA	1545	0				32777	2	1559
ENDSUBENT	1558	0				32777	299999	
SUBENT	32777003	20110408				32777	3	1
BIB	2	6				32777	3	2
REACTION	(92-U-FUL(X,X)O-NN-1,,DE,,SPD/REL)					32777	3	3
COMMENT	Ni-58(83.15 g/cm2),V(24.44 g/cm2),Al(5.4 g/cm2),					32777	3	4
	B-10(0.5 g/cm2), and S(147.78 g/cm2) were used as					32777	3	5
	filter components.					32777	3	6
	Experimental shape was obtained by differentiation of					32777	3	7
	the instrumental proton recoil spectrum LND-281.					32777	3	8
ENDBIB	6	0				32777	3	9
NOCOMMON	0	0				32777	3	10
DATA	3	431				32777	3	11
E	DATA	DATA-ERR				32777	3	12
EV	ARB-UNITS	ARB-UNITS				32777	3	13
48793.33	0.487	0.008				32777	3	14
48831.11	0.698	0.013				32777	3	15

In COMMENT or in the line with REACTION we can write the additional information about given spectrum: libraries used in calculations, components of the neutron filter, etc.

To refer to the used neutron spectrum from the subentry 32217003, which contains the measured average cross section data, we can use there the keyword
INC-SOURCE (**REAC, 32**777**002**) and (**REAC, 32**777**003**):

SUBENT	32217003	20110318	20110323	20110323	3148	32217	3 1
BIB	4	24				32217	3 2
REACTION	(73-TA-181(N,G)73-TA-182,,SIG,,SPA)					32217	3 3
INC-SOURCE	(REAC,32777002) Calculated neutron spectrum					32217	3 4
	(REAC,32777003) Experimental neutron spectrum					32217	3 5
ANALYSIS	For determination of sample activities, nine gamma					32217	3 6
	lines of W-182 were selected: 152, 179, 222, 229, 264,					32217	3 7
	1121, 1189, 1221 and 1231 keV.					32217	3 8
ERR-ANALYS	(ERR-T)Absolute uncertainty of cross section-					32217	3 9
	it includes the uncertainties of-					32217	3 10
	(ERR-1)Error in extrapolated cross-section - it					32217	3 11
	includes the uncertainties of-					32217	3 12
	error in determination of sample activities 1.3-4.4%					32217	3 13
	statistical error in peak area 1.2-21.1%					32217	3 14
	error in gamma-line efficiency 4.2%					32217	3 15
	error in quantum yield gamma-lines 0.05-0.48					32217	3 16
	(ERR-2)Error in determination of Ta sample mass 0.057%					32217	3 17
	(ERR-3)Error in determination of neutron flux - it					32217	3 18

Thank You

for your attention!