BROOKHAVEN NATIONAL LABORATORY

MEMORANDUM

CP-C/151

DATE: October 18, 1985

TO: Distribution

FROM: V. McLane

SUBJECT: Delayed-Neutron-Emission Spectra Dictionary 25 Addition

As agreed at the NRDC Meeting in Paris, we will begin transmitting delayed-neutron-emission spectra using a variable target nucleus. The proposed EXFOR and LEXFOR updates are attached.

Please add to Dictionary 25 (Data Unit Keywords)

     PC/DECAY   Per-cent per decay

VMcL:anl

Distribution

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d/f:10.3.1/CPC/CP-151

Variable Nucleus

In the case of the processes specified below, the data table may contain yields or production cross-sections for several nuclei, which may be entered as variables in the data table.

In this case either SF1 or SF4 of the REACTION keyword contains one of the following codes:

ELEM - If the Z (Mass number) of the reaction product is given in the DATA table.

MASS - If the A (atomic weight) of the reaction product is given in the DATA table.

ELEM/MASS - If the Z and A of the reaction product are given in the COMMON section or DATA table.

The nuclei are then entered in the data table as variables under the data headings ELEMENT and/or MASS with units NO-DIM.

If the data headings ELEMENT and MASS are present, a third field with the Data-Heading Keyword ISOMER is used when isomer states are specified:

0. = ground-state (used only if nuclide has also an isomeric state)
1. = first metastable state
   or: the metastable state when only one is considered
2. = second metastable state
   etc.

Decay-data for each entry under ELEMENT/MASS/(ISOMER) and their related parent or daughter nuclides can be given in the usual way under the BIB keyword DECAY-DATA. Entries under the data headings ELEMENT/MASS/(ISOMER) can be linked to entries under DECAY-DATA (and RAD-DET if present) by means of a "decay flag" (see pages 6.10, 8.D.1, and Lexfor Flags). - If the half-life is the only decay data to be given, this can be entered in the DATA table under the heading HL.

Restrictions of use:
Only SF1 or SF4 may become variable by using this formalism.

The formalism of the 'variable nucleus' may be used:

for SF1 only when
- SF6 contains the code PN (delayed-neutron emission probability)

for SF4 only when
- SF3 contains one of the process codes
   X - production of the product nuclei specified
   F - fission
   XN - variable number of neutrons (see page 6.8)
   YP - variable number of protons (see page 6.8)

See also LEXFOR Reaction Products.

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LEXFOR

For the preceding quantities, the nucleus to be entered is the target nucleus before the absorption of the incident particle.

For spontaneous fission enter the fissioning nucleus and code as a nuclear quantity. See LEXFOR Nuclear Quantities.

Delayed-neutron Emission Probability (Pn value)

Definition: Neutron yield per beta decay for a given nucleus
This is a decay quantity of the fission product nucleus and is independent of the fissioning target nucleus.

It is related to the fission yield by

$$Pn = \frac{\text{absolute delayed neutron yield}}{\text{cumulative yield}}$$

REACTION coding: (Z-S-A(0,B-),,PN)
or (ELEM/MASS(0,B-),,PN)

-where Z-S-A is the fission product nucleus (precurser nucleus before beta decay)
The fission product nucleus may also be entered as a variable in the data table, in which case, the code ELEM/MASS is entered into SF 1 of the REACTION string.

Units: PC/DECAY

For delayed neutron emission probabilities see for example:

Amarel, et.al., J.Inorg.Nuc.Chem., 31, 577 (1969)
Tomlinson, et.al., J.Inorg.Nuc.Chem., 33, 3609, (1971)
Asghar, et.al., Nucl.Phys.A, 247, 359, (1975)

Data not presently compiled in EXFOR

- The energy spectrum of all delayed neutrons together is time dependent, due to the contributions from the different half-life groups.

- The delayed-neutron equilibrium spectrum as found in a steady-state reactor

There are other delayed-neutron quantities which are not properties of the fissioning nucleus but decay properties of the fission-product nucleus which is the "precursor" of the delayed neutron. Quantities in this category which are presently not coded in EXFOR.

- the energy spectrum of the neutrons emitted by a specific precursor.

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