DA/324-0

MEMO CP-C/79

Date: Distribution

From: Thomas W. Burrows TWB Brookhaven Nat. Lab.

Subject: Transmission of Charged Particle Bibliography Tapes

We would like to propose the following format for the transmission of the Charged-Particle Bibliography.

Cols. 1-5	Arbitrary Reference Block Number (unique for all references pertaining to the same measurement)
Cols. 6-77	Cards A and B as currently defined. A-Card Reaction B-Card Reference
Col. 78	Operation Code (currently only the operation code "A" for new entries is used)
Cols. 79-85	Arbitrary key number for reference
Col. 86	Card Type A- Reaction B- Reference

REGISTRY SERVICES
ORIGINAL FORWARDED TO: J. J. Schmidt
FOR ACTION 80/10/20
cc:

The major difference between this format and the previous format is the omission of the sort keys at the beginning of the reference. Minor changes have also been made in the size of the block number field (previously called "tie-back" number) and keynumber field (previously called "sequence" field).

We will distribute the current file in this format on October 30, 1980. We will transmit, at 6 months intervals, updates to the file (additions and modifications).

If further information is desired in the transmission, such as sort keys or the distributions for ELEM/MASS, ELEM, and MASS, we will add such information when a consensus is reached among the recipient centers. If the final format differs from the trial format we are proposing, we will retransmit the entire file in the final format and then again begin 6 months updates.

cc. Cullen, Lemmel, Seito, Day Day, Okamoto, Hendrickson, Pronyaev, Schmidt, Lammer, Schwerer

Sol Pearlstein

Sol Pearlstein

034346

TWB:kh

Distribution: H. Behrens, F.E. Chukreev, G. Dearnaley, R.J. Howerton, V. Manokhin, A. Marcinkowski, H. Muenzel, S. Pearlstein, J.J. Schmidt, H. Tanaka, N. Tubbs, NNDC

Memo CP-C/78

Date: September 19, 1980

From: V. McLane

Subject: LEXFOR entry: Fission-Neutron Spectra Data
LEXFOR entry: Isomeric States
LEXFOR entry: Standards

Enclosed are proposed LEXFOR entries on Fission-Neutron Spectra Data, Isomeric States and Standards.

The Fission-Neutron Spectra Data entry is mainly a rearrangement to a format consistent with other LEXFOR entries and an update to REACTION formalism.

The entry on Isomeric States also includes a new definition section.

Sol Pearlstein

kh

Distribution: H. Behrens
F.E. Chukreev
G. Dearnaley
V.Manokhin
A. Marcinkowski
H. Muenzel
S. Pearlstein
J.J. Schmidt
H. Tanaka
N. Tubbs
NNDC

Fission-Neutron Spectra Data

Theory

Fission-neutron spectrum data are fitted either to a Maxwellian or to a Watt spectrum or to one of several other defined spectra.

The Maxwellian spectrum has the shape:

$$N(E) \sim \sqrt{E}\ \exp(-E/T)$$

where E is the energy of the fission neutron and T is the spectrum temperature given in Mev. Also often given are the average kinetic energy $\overline{E}$ and the most probable energy E_p which are defined as:

$$\overline{E} = 3T/2$$

$$E_p = T/2 = \overline{E}/3$$

The Watt spectrum is based on the assumption that fragments emit neutrons with a Maxwellian spectrum in the center-of-mass system. The shape of the Watt spectrum is:

$$N(E) \sim \exp(-E/T)\ \sinh\left(\frac{2}{T}\sqrt{EE_f}\right)$$

where T is the spectrum temperature given in Mev but deviating from the temperature defined in the Maxwellian fit; E_f is a theoretical "fragment kinetic energy per nucleon". The average kinetic energy $\overline{E}$ is defined here as:

$$\overline{E} = E_f + \frac{3T}{2}$$

The numerical value of $\overline{E}$ should be approximately the same disregarding the spectrum shape to which the data were fitted.

Fission spectrum average cross-sections are defined as:

$$\overline{\sigma} = \frac{\int \sigma(E) N(E) \sqrt{E}\ d^E}{\int N(E) \sqrt{E}\ dE}$$

The knowledge of the shape of the fission spectrum is developing, and Maxwellian and Watt spectra are now considered only as rough approximations. Presently preferred is a "double Watt spectrum". The Cf-252 spectrum, which is more accurately known, suggests that none of the presently used fits is sufficient. Therefore, it is most important to compile point data of the energy distribution of fission neutrons. However, it is also desirable to compile mean-energy values because they are rather independent of the spectrum shape assumed and frequently needed for measurement analysis (detector response, etc.).

References

James Terrell, "Fission Neutron Spectra and Nuclear Temperature", Phys. Rev. 113, p.527 (1959)

"Prompt Fission Neutron Spectra", Vienna, 1979

Data to be compiled in EXFOR

1. Energy spectra of fission neutrons

In the literature, these data are usually called $\chi(E)$. Data are usually given in arbitrary units, which requires the REL modifier in the quantity code. In the normalized form $\int \chi(E)\, dE = 1$, data have the units of a reciprocal energy.

The data are functions of the outgoing-neutron energy (E), and incident-projectile energy (EN).

Examples:

---(-,F,PR,DE,N)	Energy spectrum of prompt fission neutrons
---(-,F),,DL,DE,N)	Energy spectrum of delayed neutrons
---(-,F),,DL/PAR,DE,N)	Energy spectrum for a specific delayed neutron group

2. Fitting parameters of fission-neutron spectra

Since the average kinetic energy $\overline{E}$ is the only quantity which is comparable in all fits, EXFOR entries should be made for this quantity.

Example:

---(-,F),PR,AKE,N) Average kinetic energy of prompt neutrons.

Details of the fit and of the spectrum shape assumed should be given under ANALYSIS.

August 1980

3. Fission neutron spectrum averaged cross-sections are entered with the modifier FIS.

It must be evident in the EXFOR entry whether the data were:

- measured directly. The method should be specified under METHOD. Under INC-SPECT, the kind of spectrum and the nuclide and incident-projectile energy from which the fission-neutron spectrum is produced should be specified.

- calculated by integrating a measured cross-section curve over an assumed fission-neutron spectrum. This is specified using the code 'DERIV' in REACTION SF9. An entry should also be made under ANALYSIS. It is essential to give the assumed spectrum type and its parameters, as well as how the fit was made (e.g. in a N(E)-versus-E scale or in a N(E)/ $\sqrt{E}$-versus-E scale.

See Spectrum Average for specification of incident spectrum.

Isomeric States

Definition:

An isomeric state is defined as a long-lived energy state, where long-lived is, generally, accepted to mean having a measurable half-life (i.e., greater than ~10E-5 sec).

For practical applications, a Metastable state shall be defined in EXFOR as an energy state having a half-life of the order of 0.1 milliseconds or longer.

The term isomeric states shall refer to the ground and known metastable states.

Coding:

In the case where a nucleus has a known metastable state, the isomeric states are indicated by an isomer code following the isotope code, e.g., 95-AM-242-M1. (See EXFOR page 8.2 for a complete list of isomer codes.)

The assignment of isomeric states for a given nucleus may vary in the literature according to the growing knowledge of a particular nucleus. In order to define an isomeric state uniquely, at least the half-life for the isomer must be coded (see Decay Data and Half Lives). Any other information about its decay properties, if given by the author, should be included under the keyword DECAY-DATA.

Partial reactions leading to isomeric states are coded by entering the isomer code in REACTION SF4. Sums and ratios are given algebraically (see EXFOR page 8.R.6).

Examples: 39-Y-87-M/G
49-IN-114-M+G/T

When nuclei are coded within a data table using the data headings ELEMENT and MASS, numerical isomer codes are used under the data heading ISOMER as defined on EXFOR page 6.7 (Variable Product Nucleus) and 8.R.5.

If only the activity of the ground state was measured, and feeding from the metastable state via isomeric transition is possible, one of the branch codes following (REACTION SF5) should be used. (In the case where there is no isomeric transition to the ground state, they should not be used.)

M+ - Including formation via isomeric transition
M- - Excluding formation via isomeric transition
(M) - Uncertain whether formation via isomeric transition is included

When the data measured for the ground state is assumed equal to the total reaction (i.e., it includes 100% of decays by isomeric transition), it should be coded as a total reaction, except in the case where the total formation is obtained from separate measurements, or from a daughter activity ensuring 100% inclusion of the produced isomers, in which case the sum coding should be used (see above).

See also Cross-Sections.

Standards

Standard and/or monitor information should be entered into an EXFOR data set using the Information-Identifier Keyword MONITOR (see EXFOR page 8.M.2 for coding rules).

Standard information should be coded except when it is not relevant, as for quantities which are usually obtained without a standard, that is:

- total cross sections
- nuclear quantities (see Nuclear Quantities)
- ratios
- quantities defined using the modifiers RS, RSL, RSD, REL
- scattering radius, strength function, average level spacing
- resonance parameters; however, for resonance areas, peak cross sections and similar quantities, either the standard should be given or a cross-reference to the data from which the resonance parameters were deduced.

For all other quantities which can be measured either with a standard or absolutely, the positive statement in free text that the data are measured absolutely is pertinent information and, therefore, should be included.

It should be noted, however, that so-called "absolute" data ofter depend on the assumption of certain numerical values (e.g., for calibrations or corrections); it is desirable to give such values in free text. The compiler should restrict the use of the term absolute to those cases in which it is sure that there are no "hidden" standards.

For complicated descriptions of standards or normalization procedures, a cross-reference to published literature may be sufficient.

The reference pertinent to the standard(s) used is coded using the Information-Identifier Keyword MONIT-REF (see EXFOR page 8.M.3 for coding rules).

Decay data for the standard(s) used is coded using the Information-Identifier Keyword DECAY-MON (see EXFOR page 8.D.4 for coding rules).

Entry of standard values into DATA or COMMON

1. If standard values are given at several energies, these values are given in the data table as an additional field under the data heading MONIT (see example 4a).

2. If only one standard value is given, there are two possibilities:

   - the standard is entered as in case 1, above; the field headed by MONIT is blank for all but one line.

   - the standard is entered in the COMMON section under the data heading MONIT. The incident energy, secondary energy, and/or angle at which the normalization was done are entered under the data headings EN-NRM, E-NRM, ANG-NRM, respectively. These are omitted if the data table includes only one data point for which the independent variables are the same as those for the normalization value.

3. If the originally measured ratio (data/standard) is also given, see Example 2.

4. If the data are normalized at two or more energies in an unspecified way, this should be noted in free text in an appropriate place.

   Note: Every data line must have a dependent variable entry, therefore, standards may not be entered on a separate line in the data table.

5. If two or more standard reactions are given for the same data set, see EXFOR page 8.S.1 for coding rules.