(3) EXFOR

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SUBJECT: Isomeric States

In looking at the compiled data for the production of isomeric states, it is clear there is much confusion among experimentalists and compilers as to what is actually being measured.

According to the EXFOR definition, if the branch field is blank, independent production of the product nucleus is assumed, i.e., formation via radioactive decay is excluded. The branch code "CUM" includes formation via radioactive decay and isomeric transition.

By this definition, for isomeric state production, where no branch code is given in the reaction string it is assumed that radioactive decay and isomeric transition are not included. This is not what is being measured by most experimentalists. Radioactive decay from other levels is almost always included and in some cases isomeric transitions from short-lived isomers is included.

Because of the way definitions are worded, many quantities may be coded in more than one way causing confusion and making automatic processing of the data difficult. For example:

1. The total cross section for the production of a nuclide having a metastable state may be coded with no isomer extension or with the extension M+G.

2. The product of the first metastable state including decay from a higher metastable state may be coded with the isomer extension M1+M2 or with the isomer extension M1 and the branch code M+.

Both of these examples have the additional complication that the parameter field requires the code "SUM" for one way of coding and not for the other.

cc Arcilla, Lammer, Schmidt, Cullen, Lemmel, Schwerer, Gandarias, Okamoto, Seits, Goulo, Oshomawe

To help clarify matters the following definitions under LEXFOR Cross Sections and LEXFOR Isomeric States should be changed.

1. In all cases, "radioactive decay" should read, "radioactive decay from other nuclides". (This would change the meaning of the branch code "CUM". How has it been used in the past by the charged-particle compilers?)

2. The definition of M+ should read, "only the activity of the isomeric state specified is measured".

3. The total production cross section for a given nuclide should be coded without an isomeric state extension regardless of how it was obtained.

Care should be taken by compilers to determine what was measured and to compile it as accurately as possible.

Coding examples:

(-,-)Z-S-A,,SIG) total nuclide production.

(-,-)Z-S-A-G,,SIG) production of ground state, excluding formation by isomeric transition.

(-,-)Z-S-A-M1,M+,SIG) production of first metastable state including isomeric transitions from higher isomeric states.

Short-lived Isomers

There is a need to better identify data for the production of short-lived isomeric states (<.1msec).

Under the present coding rules, the reaction product would have to be given without an isomer extension. Under DECAY-DATA this implies that the decay information given is to the ground state, so it is not possible to legally code the decay information. (In practice, compilers have been using illegal metastable state extensions). The reaction presently must be coded as follows:

REACTION: (Z-S-A(-,-)Z'-S'-A',PAR/CUM,SIG)

with the level energy in the data section and decay information in free text.

I propose adding the isomer code "S" to be used to identify all short-lived isomers, that is, no number would be attached to differentiate different levels.

A LEXFOR entry update is attached.

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VM:al

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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-M1+M2/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.7.

If only the activity of the isomeric state specified 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 isomeric state specified, 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

See also Cross-Sections.