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MEMO CP-A/14

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To:distribution
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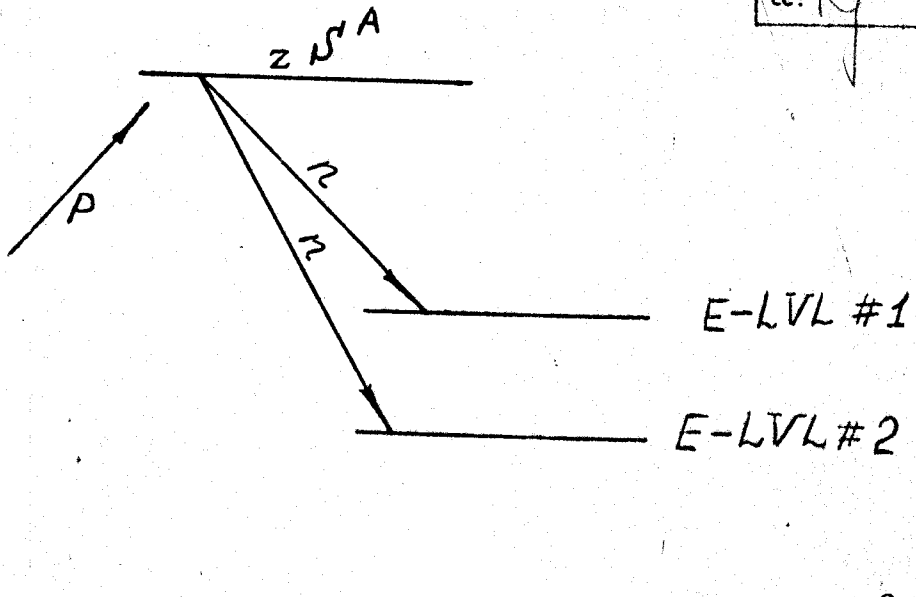
Subject:about the coding rules of the some reactions and the application of formalizm "Partial Reactions"

In compiling number of papers we encountered with the some difficulties. There is also a possibility to lose part of the information from those papers. In this connection we propose:

1.The reactions, which directly lead to production of final nucleus (product nucleus) in the excited state (no metastable state) with an emission of particle (or particles) coded in SF3(fig.1), must be identified by the code "E" denoting the excited state of the product nucleus coded in SF4 and code "PR" in SF5. Proposed name of SF5 subfield is "prompt" production of product nucleus.

For example:

(Z-S-A(p,n)Z'-S'-A'-E,PR,SF6,SF7,SF8,EXP)
FIG.1.



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An unambiguous identification of the excited level is made by indicating of its energy given under data-heading keyword "E-LVL" in the "DATA" or "Common" section.

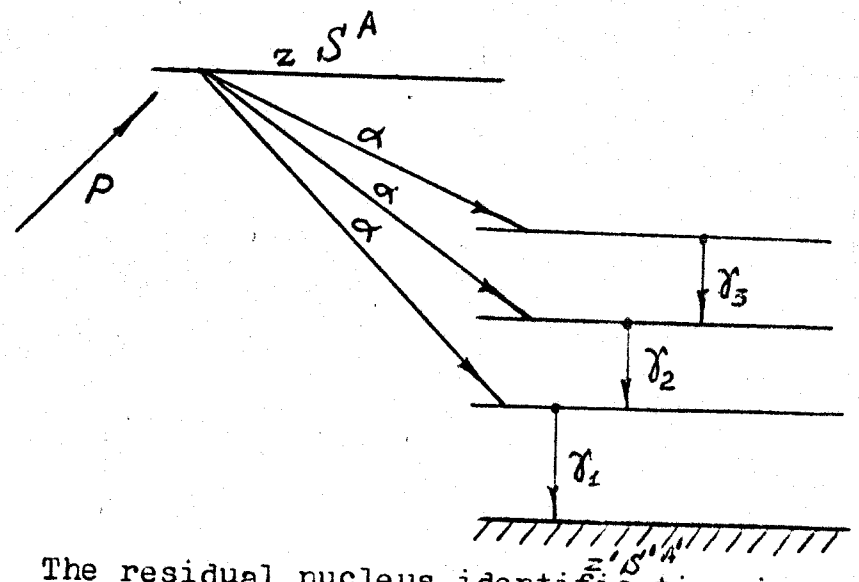
The application of proposed description of such reactions will entail some changes in the following pages of the "Manual":

VIII.2. (EXFOR), "CROSS-SECTIONS" (IEXFOR) and also in the dictionary 31: PR-prompt, without "in fission". The changed version of these pages are attached.

1a.To save the coding rules of those reactions which lead to isomeric states (according to dictionary 27).

2.To save the former formalizm "Partial Reactions" (code "PAR" in SF5) for those reactions which lead to the residual nucleus, emitting a specific gamma or particles groups (Fig.2), for example: (Z-S-A(p,α)Z'-S'-A',PAR,SIG,G,,EXP)

FIG.2.



The residual nucleus identification is made by indicating of energy of an observable γ —transitions (for example, γ_2), given under data-heading keyword "E" in "Common" or "Data" sections.

Also to save the former formalizm "Partial Reactions" (code "PAR" in SF5) for partial reactions, leading through different mechanisms to the same endproduct. (example, see IEXFOR,"Partial Reactions").

The proposal of the first item will entail some changes in the page "Partial Reactions"(LEXFOR). The changed version of this page are attached.

Clearance

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Partial Reactions

Partial Reactions

Partial reactions are coded with the code "PAR" (in quantity-subfield 3 in ISO-QUANT formalism, or in REACTION subfield 5).

The code PAR is restricted to partial reactions leaving the residual nucleus in a specific level or emitting a specific gamma or particle group.

See examples under Inelastic Gamma-Emission and Inelastic Scattering.

The code PAR is not used for partial reactions leaving the residual nucleus in an isomeric state. See under Isomeric States and in chapter VIII under REACTION.

The code PAR may also be used for partial reactions leading through different mechanisms to the same endproduct. Example: The reaction

6-C-12(N,N+3A)

may proceed through any of the following mechanisms

6-C-12(N,A)4-BE-9*(N)4-BE-8*(2A)
6-C-12(N,A)4-BE-9*(A)2-HE-5*(N+A)
6-C-12(N,N')6-C-12*(A)4-BE-8*(2A)
6-C-12(N,N')6-C-12*(3A)

All these partial reactions are coded as

(6-C-12(N,N+2A)2-HE-4,PAR,SIG)

with free text explanation such as "PARTIAL REACTION VIA ...". Some additional information may be given in coded form

either by specifying excitation-energies as described on page VIII.EN-SEC,

and/or by using, where applicable, a REACTION (ISO-QUANT) combination with the "also" separator, for example

((6-C-12(N,N+2A)2-HE-4,PAR,SIG)=
(6-C-12(N,A)4-BE-9,PAR,SIG))

Compilers should try to achieve this way a unique identification of the partial reaction, as far as this is possible.

If ratios of such partial reactions are given, it may occur that both units of the ratio have identical codes, both using the code PAR, with explanation given in free text.

This formalism does not always permit a perfect computer-identification of each partial reaction. Therefore, this formalism should be regarded as preliminary and corresponding Exfor entries will have to be converted when a more perfect coding scheme has been designed and agreed.

Particle-out Reactions

In the 'REACTION' formalism the coding of particle-producing reactions creates no problems (see page VIII.REACTION). In the older 'ISO-QUANT' formalism, where only 3 characters were available for the reaction code, the following neutron-induced "particle-out" reactions are defined:

N2N Interaction in which two neutrons and perhaps other particles are emitted. Not to be used for the (n,2nf) reaction.

N3N Interaction in which three neutrons and perhaps other particles are emitted.

N4N Interaction in which four neutrons and perhaps other particles are emitted.

NP Two-body interaction which results in emission of one proton and no other particle.

NNP Interaction which results in emission of one neutron, one or more protons and perhaps heavier particles.

N2P Interaction in which two or more protons and perhaps other heavier particles are emitted.

ND Two-body interaction which results in emission of one deuteron and no other particle.

NND Interaction which results in emission of one neutron, one or more deuterons and perhaps heavier particles.

NT Two-body interaction which results in emission of one triton and no other particle.

NNT Interaction which results in emission of one neutron, one or more tritons and perhaps heavier particles.

N3 Two-body interaction which results in emission of one He-3 particle and no other particles.

NN3 Interaction which results in emission of one neutron, one or more He-3 particles and perhaps heavier particles.

NA Two-body interaction which results in emission of one α-particle and no other particles.

N2A Interaction which results in emission of two or more α-particles.

NPA Interaction which results in emission of a proton and an α-particle (usually not occurring below 20 MeV).

NNA Interaction which results in emission of one neutron, and one or more α-particles.

For more detailed quantity-codes see dictionary 14. The above definitions refer to specific processes. See also under Light-Nuclei Reactions

For cross-sections resulting from a sum of several particle-out processes see Production Cross-Sections. The above definitions exclude fission. Quantity-codes for reactions like (n,2nf) have not yet been defined.

For the coding of cross-sections see Dictionaries 14 and 36 and the Manual pages VIII.12-VIII.20c. Below some cases requiring specific explanation, are given.

Independent and cumulative cross-sections

The coding of cross-sections requires special care when the formation of the residual nucleus can occur

- by direct (= independent formation), and/or
- via isomeric transition, and/or
- via radioactive decay.

The following examples are given in REACTION formalism:

code	application
,SIG	independent formation of the product nucleus can be assumed, but no definitive statement was given by the author
M+,SIG	only the activity of the ground-state was measured which includes however the feeding from a metastable state via isomeric transition. See also under Isomeric States.
IND,SIG	independent formation of the product nucleus, and it was clearly specified by the author that the formation via radioactive decay was excluded
IND/M+,SIG	formation of the product nucleus including independent formation and formation via isomeric transition
(CUM),SIG	the inclusion of the formation via radioactive decay was assumed by the compiler, but no definitive statement was given by the author
CUM,SIG	the cross-section includes the formation via radioactive decay and isomeric transition
CUM/M-,SIG	the cross-section includes the formation via radioactive decay but excludes the formation via isomeric transition
CUM/(M),SIG	the cross-section includes the formation via radioactive decay, the inclusion or exclusion of formation via isomeric transition is uncertain
PR,SIG	prompt formation of the product nucleus

Fission cross-sections see under Fission

Cross-sections leading to isomeric states see under Isomeric States

3. Coding of nuclides

Nuclides appear in the coding of many keywords. The general format is Z-S-A-X

where Z is the charge number, up to 3 digits, no leading zeros;
S is the element symbol; 1 or 2 characters; see Dictionary 8 for the agreed list of element symbols;
A is the mass-number; up to 3 digits, no leading zeros;
X is ~~an isomer~~ code denoting the isomeric (or excited) state. It may have the following values:

G for the ground state of a nucleus which has a metastable state,
M if only one metastable state is regarded,
M1 for the first metastable state,
M2 for the second, etc.
(or excited)
E for any excited state

If no isomeric state applies, "-X" is omitted and the nuclide is coded in the form Z-S-A.

Exceptions to this coding exist for the following cases:

target nucleus, coded in the first subfield under the keywords REACTION, ISO-QUANT, CMPD-QUANT, NUC-QUANT.

incident particle, coded in the second subfield under REACTION.

product nucleus, coded in the fourth subfield under REACTION.

See on the following pages under the pertinent keywords.