Memo 4C-3/241

1980-07-24

To: Distribution

From: G. Lammer, M. Lammer, H.D. Lemmel

Subject:
1. Coding of fission asymmetry
2. Light charged particles in ternary fission
3. Ion Charge
4. Proposals for LEXFOR
5. Fission yields

References:
re 1., Memo CP-C/61; action of 4th NRDC Meeting
re 3., Recommendation of 4th NRDC Meeting
re 5., Memo 4C-2/112

1. Fission Asymmetry

It was noted earlier that the code ASY was used in EXFOR for two different purposes, and this was found to be disturbing in case of retrievals. We propose to maintain the code ASY for the case of asymmetry in polarization etc, and to introduce a new formalism for the fission asymmetry.

We propose to add in Dictionary 33 (REACTION SF7) the following particle codes:

HF	HEAVY FRAGMENTS
LF	LIGHT FRAGMENTS

in addition to the existing code 'FF'. These codes would solve several coding problems.

The 'fission asymmetry' (= ratio of the mean mass AP of the heavier fragments over that of the lighter fragments) would then be coded as:

((...(N,F),,AP,HF)/(...(N,F),,AP,LF)) where 'mean mass' = $\frac{\Sigma \text{ mass} * \text{yield}}{\Sigma \text{ yield}}$

The following codes should then be deleted:

,PØL,FF,ASY	from Dict. 36	both from Dict. 41
NF,ASY,FF	from Dict. 14	

Centers would be asked to revise their entries accordingly.

Distribution:

Clearance: J.J. Schmidt

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[Note: In EXFOR 40031. the ISO-QUANT 'NF,ASY,,FF' is used, but the quantity meant is:

'angular anisotropy of fission fragments' which should be coded as ,DA,FF,RSD.

We would like to request CJD to correct and retransmit this entry.]

If the codes HF and LF are accepted, they could also be used in connection with other quantities, existing in the literature such as:

((...TER,AP,HF)/(...BIN,AP,HF)) = the ratio of most probable heavy masses in ternary and binary fission

,AKE,HF = average kinetic energy of heavy fragments

,COR,A/HF = angular correlation of alpha particles versus heavy fragments.

2. Light charged particles in ternary fission

In ternary fission experiments, the individual light charged particles are sometimes not distinguished (see e.g. the article in J. of Phys./G 5 (1979) 319).

For such cases, we propose to introduce in Dict. 33 the code:

LCP LIGHT CHARGED PARTICLE

Examples existing in the literature are:

TER,FY,LCP	Light charged particle yields in ternary fission
TER,CØR,LCP/FF	Angular correlation of light charged particles and fission fragments
TER,AKE,LCP	Average kinetic energy of light charged particles in ternary fission

3. Ion Charge

We received TRANS 2059 containing EXFOR 21054 where the data heading Keyword 'ION CHARGE' is already used. For this entry, the introduction of this keyword appears to be necessary as distinct from the heading ELEMENT, but we would prefer receiving an accompanying LEXFOR entry.

4. Proposed additions and alterations to LEXFOR

a. Add to the 'Definition' in LEXFOR entry Fission, after the paragraph on binary fission:

In the commonly examined cases of neutron binary fission, the fissioning nucleus divides with high probability into two unequal fragments, a heavy and a light one. The ratio of the mean mass AP of the heavier fragments over that of the lighter fragments is called 'Fission Asymmetry'. See coding example further below.

b. Also in LEXFOR 'Fission', add after the paragraph 'Fission-product yields':

Quantities related to the bulk of the heavy (light) fission products: The codes HF (for heavy fragments) and LF (for light fragments) are used in SF7 (particle considered).

Examples

(92-U-235(N,F),,AKE,HF) = average kinetic energy of the heavy fragments

((92-U-235(N,F),,AP,HF)/(92-U-235(N,F),,AP,LF)) = fission asymmetry

c. LEXFOR entry Fission, paragraph 'Ternary fission':

replace 3rd to 6th line by

Frequently, the ternary fission is further specified by the accompanying light particle, e.g. 'alpha accompanied ternary fission'. Such information may be coded by specifying the light particle in SF4, like:

(92-U-235(N,F)2-HE-4,TER,SIG) = cross-section for alpha accompanied ternary fission

This is a partial cross section of

(92-U-235(N,F),TER,SIG)

where all light charged particles occurring in ternary fission are considered. In the latter case, e.g. in an angular distribution, the 'light charged particles' may have to be coded explicitly in SF7 using the code LCP:

(92-U-235(N,F),TER,DA,LCP) = angular distribution of the light charged particles in ternary fission.

5. Fission yields

We agree to Memo 4-C 2/112 about coding of fission product yields and suggest that NNDC merges it into the existing Lexfor entry.

However, we suggest some changes as indicated on the following pages. For the very last examples we refer to the memos 4C-4/30 and 4C-3/234 where the same topic had already been discussed.

We also suggest not to introduce any new ISO-QUANT codes, i.e. to omit those ISO-QUANT coding-examples that do not exist in the files.

= 4C-2/112 rev

To Distribution

From P.D. Johnston

Subject EXFOR Coding of Fission Product Yields

16 July 1980

The implementation of a computational format for Fission Product yields has shown a number of inconsistencies and errors in EXFOR coding of Fission Product yield data. There are in particular two areas where care is needed; the specification of isomeric states of products, and heading and units for fractional and relative yields.

Isomeric states

From my reading of the manuals there are three valid ways of coding isomeric states for fission products.

a) For a unique product, the Reaction code, SF4 should contain, where appropriate -M.

b) For a table of various product yields where Decay Data is available, the -M extension should be used in Field one of the DECAY-DATA code.

c) Where no Decay Data is available the ISOMER column heading with value 1. or 2. may be used following the ELEMENT and MASS column headings.

Fractional Yields

These should always be coded as explicit ratios of the independant or cumulative yields over the chain yield, resp. as ratio of the independent over the cumulative yield. The column heading should be RATIO (or DATA) units NO-DIM, and the values may only be in the range from zero to unity. (i.e. not percentage).

Relative yields (arbitarily normalised to a particular product yield of unity) should be coded with REL in SF8 of the Reaction code, with column heading DATA and units ARB-UNITS.

None of these rules are new, but having reviewed the data in EXFOR, I felt that an explicit reminder would help to clarify the situation.

I also include a proposal replacement and extension of the LEXFOR manual entry for coding Fission Product yields, including a definition of a new branchcode, CHG, (Reaction SF5) for charge yields, used in EXFOR works 21549 and 21550.

To be included in Lexfor under Fission Yields: = 4C-2/112 rev

Fission Yields

Definition Scission of a heavy nucleus into two, or occasionally three, fragments produces nuclei which undergo a sequence of de-excitations. The yield of a nucleus of specified Z and A is usually measured as a percentage yield per fission of the heavy target nucleus fissions.

Primary Fission Fragment yields

The percentage yield per fission of nuclei of specified Z and mass, or specified mass, before prompt neutron-emission which takes place around 10^{-18} secs after fission and is finished within about 10^{-14} secs.

ISO - QUANT	REACTION
NF, YLD, PRE	(N,F) ELEM/MASS, PRE, FY

Secondary Fission Fragment Yields

The percentage yield per fission of nuclei of specified mass, after prompt neutron emission, but before beta decay or delayed neutron emission.

ISO - QUANT	REACTION
NF, YLD, SEC	(N,F) MASS, SEC, FY

Independent Fission Product Yields

The percentage yield of nuclei of specified Z and mass after prompt neutron emission, but before beta decay or delayed neutron emission.

ISO - QUANT	REACTION
NF, YLD, IND	(N,F)ELEM/MASS, IND, FY

Cumulative fission Product Yields

The cumulative yield of nuclei of specified Z and Mass , including the independant yield plus the additional yield from beta decay and delayed neutron emission of neighboring nuclei.

ISO-QUANT	REACTION
NF, YLD, CUM	(N,F) ELEM/MASS, CUM, FY

Total Chain Yield

The sum of the cumulative yields of all stable fission products having a specified mass

ISO-QUANT	REACTION
NF, YLD, CHN	(N,F) MASS, CHN, FY

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Fractional Yields

Fractional independant or cumulative yields relative to the chain yield for a specified mass.

ISO-QUANT	REACTION
(NF,YLD,IND)/(NF,YLD,CHN)	(N,F)ELEM/MASS,IND,FY)/(N,F)MASS,CHN,FY

NB: HEADING RATIO (or DATA); UNITS NO-DIM

Other types of "Fractional Yields" can be coded in a similar manner, e.g.

REACTION

((..(N,F)54-XE-135,IND,FY)/(..(N,F)53-I-135,CUM,FY))

Most Probably Charge ZP

The most probable charge, according to a charge distribution function (usually Gaussian), of the primary fission fragments or products of a specified mass

ISO-QUANT	REACTION
NF,ZP	(N,F)MASS,ZP

Charge Yields or Elemental Yields

The summed yields for a specific product Z, before beta decay processes.

REACTION

(N,F)ELEM,,FY

The most probable mass, according to a mass distribution function, for a given element

REACTION

(N,F)ELEM,,AP

Note that this code is to be distinguished from

(N,F),,AP,HF

which is the mean mass of the heavier fission fragments; compare 'Fission Asymmetry' in the Lexfor entry on Fission.