

## Use of pointer for independent variable

(N. Otsuka, 2022-08-24, Memo CP-D/1056)

EXFOR Formats Manual Chapter 6 gives the following three restrictions for use of the multiple reaction formalism:

- 1) The incident projectile and the target nucleus are constant.
- 2) Quantities are functions of the same independent variables.
- 3) Quantities are integrally related to each other.

Because of the second restriction, we cannot compile some pairs of two quantities even if they are integrally related. An example of such a pair is the cumulative fission product yield and chain fission product yield. The chain yield is often derived (extrapolated) from the cumulative yield (*e.g.*, by using Wahl systematics), and they are often tabulated together (See an example below taken from H. Naik et al., Nucl. Phys. A952(2016)100; EXFOR 33098.). This table shows the chain yield is almost exhausted by the cumulative yield of the nuclide near the stability line of the mass chain. (I do not know why  $Y_C > Y_A$  in the second line of the table ....)

Table 1  
Nuclear spectroscopic data and yields of fission products in the 5.42 MeV neutron-induced fission of  $^{232}\text{Th}$ .

Nuclide	Half-life	$\gamma$ -Ray energy (keV)	$\gamma$ -Ray abundance (%)	$Y_C$ (%)	$Y_A$ (%)
$^{85}\text{Kr}^m$	4.48 h	151.2	75.0	$3.832 \pm 0.346$	$3.832 \pm 0.346$
		304.9	14.0	$3.918 \pm 0.101$	$3.846 \pm 0.101$
$^{87}\text{Kr}$	76.3 min	402.6	49.6	$5.859 \pm 0.572$	$5.877 \pm 0.574$
$^{88}\text{Kr}$	2.84 h	196.3	25.9	$5.778 \pm 0.415$	$5.872 \pm 0.422$
$^{91}\text{Sr}$	9.63 h	749.8	23.6	$5.782 \pm 0.427$	$5.782 \pm 0.427$
		1024.3	33.0	$6.223 \pm 0.683$	$6.223 \pm 0.683$

The following coding looks reasonable, but it is not allowed due to the second restriction mentioned above.

```
REACTION 1 (90-TH-232 (N, F) ELEM/MASS, CUM, FY)
          2 (90-TH-232 (N, F) MASS, CHN, FY)
...
DATA      5      136
ELEMENT   MASS   DATA 1ERR-T 1DATA 2ERR-T 2
NO-DIM    NO-DIM PC/FIS  PC/FIS  PC/FIS  PC/FIS
          36.    85.    3.832  0.346  3.832  0.346
          36.    85.    3.918  0.101  3.846  0.101
          36.    87.    5.859  0.572  5.877  0.574
```

I would like to suggest elimination of the second restriction, and addition of the cumulative and chain yields in LEXFOR "Multiple reaction formalism" as a new case.

If we remove the second restriction, then we do not need the concept of the vector common data. This is because the vector common data becomes a special case of the multiple reaction formalism if we ask repetition of the same REACTION code under all pointers. Therefore, I also suggest abolishment of the vector common data concept from our manual.

## Formats Manual Chapter 5 “Pointers”

### 1. Multiple Reaction Formalism<sup>1</sup>

In certain cases (see page 6.7 and **LEXFOR, Multiple Reaction Formalism**) more than one code unit may be given under the REACTION keyword for a subentry, each unit having its own data field(s). Each data field is then linked to the appropriate code string by means of a pointer.

*Example:*

```
BIB
REACTION 1 (92-U-235 (N, 0) , , EN)
          2 (92-U-235 (N, 0) , , J)
          3 (92-U-235 (N, TOT) , , WID)
...
ENDBIB
COMMON
MOMENTUM L DATA-ERR 1
NO-DIM     EV
...
ENDCOMMON
DATA
DATA      1 DATA      2 DATA      3 DATA-ERR
EV        NO-DIM      MILLI-EV    MILLI-EV
...
...
...
ENDDATA
```

In the example above, the field headed MOMENTUM L in the COMMON section does not have a pointer and, therefore, relates to all fields of the DATA section. The field in the COMMON section headed DATA-ERR is linked, by means of a pointer, to fields of the DATA section and to a specific REACTION code in the BIB Section with the pointer 1. Each field in the DATA section is linked to the REACTION code in the BIB Section with the same pointer.

```
BIB
REACTION 1 (92-U-235 (N, F) CUM, ELEM/MASS)
          2 (92-U-235 (N, F) CHN, MASS)
...
ENDBIB
NOCOMMON
DATA
MASS      ELEMENT    1 DATA      1 DATA-ERR  1 DATA      2 DATA-ERR  2
NO-DIM    NO-DIM     PC/FIS    PC/FIS    PC/FIS    PC/FIS
...
...
...
ENDDATA
```

In the second example, the field headed MASS does not have a pointer, and it relates to all fields of the DATA section. The field headed ELEMENT is linked to fields of the DATA section and to a specific REACTION code in the BIB section with the pointer 1.

### 2. Vector Common Data

~~Multi-dimensional tables may be coded using pointers. (See page 4.6 for alternate coding of multi-dimensional tables).~~

~~The following rules apply to the use of vector common data:~~

- ~~If a pointer links a set of independent variable data headings, (e.g., EN, ANG, E-LVL), one of which appears in the COMMON section, all other pointers will also link with the same set of independent variable data headings, i.e.; the following is forbidden:~~

~~E — 1 E — 1 E-MIN — 2 E-MAX — 2~~

<sup>1</sup> The multiple reaction formalism is used only for the specific cases listed in **LEXFOR, Multiple Reaction Formalism**.

- Units referring to a given independent variable will be the same for all pointers.
- For a given independent variable, the number of data headings repeated for each pointer will be the same.
- ~~The vector common formalism may not be combined with the multiple reaction formalism.~~

**Example:**

```

COMMON
ANG      1 ANG      2 ANG      3
ADEC     ADEC     ADEC
...
ENDCOMMON
DATA
EN       DATA     1 DATA-ERR  1 DATA     2 DATA-ERR  2 DATA     3
DATA-ERR 3
MEV     MB/SR      MB/SR      MB/SR      MB/SR      MB/SR
MB/SR
...
ENDDATA

```

## Formats Manual Chapter 6 “Reaction Specification”

### Multiple reaction formalism

If pointers are used with the REACTION keyword, the code fields associated with each pointer may be a reaction unit or a reaction combination<sup>5</sup>. The use of this formalism is restricted to specific classes of data that are subject to the following constraints (see page 5.2 for coding example).

- 1) The incident projectile and the target nucleus are constant.
- ~~2) Quantities are functions of the same independent variables.~~
- 2) Quantities are integrally related to each other.

~~The multiple reaction formalism is used only for the specific cases listed in For the specific classes of data that may be coded using the multiple reaction formalism, see LEXFOR,~~ **Multiple Reaction Formalism.**