REACTION SF2=0 and nuclear quantities (NQ)

(N. Otsuka, V. Semkova, 2016-06-24, Memo CP/D-880 Rev.)

Checking programs complain existence of a nuclide code in SF4 (reaction product) for delayed neutron emission quantities, e.g., `(37-RB-93(0,B-)38-SR-93,,PN)` due to the following rule:

> c) There is no reaction product if a nuclear quantity is given (*i.e.*, SF2 contains the code 0).

(EXFOR Formats Manual Chapter 6 "Reaction specification"). However the underlined part is obviously inconsistent with our usual REACTION coding for spontaneous fission quantities, *e.g.*,

`(98-CF-252(0,F)ELEM/MASS,CUM,FY)`

Nuclear quantities are indicated more directly by a flag `NQ` in Dictionary 236 (Quantitites) like

```
236 TRA 200902 ,LD                          NQ  1/E  Level density
```

, and we propose to use it for identification of nuclear quantities:

Proposal 1: Following change in the EXFOR Formats Manual Chapter 6:

> c) There is no reaction product if a nuclear quantity is given (*i.e.*, SF2 contains the code 0).
>
> →
>
> c) There is no reaction product if a nuclear quantity (defined in Dictionary 236 with the reaction type `NQ`).is given.

Nicolas Soppera checked side effects of this change, and found that the new rule is still inconsistent with our REACTIONl coding for scattering radius `,RAD`, which is defined with `NQ` but have been coded with a reaction product in REACTION SF4, *e.g.*,

`64-GD-155(N,EL)64-GD-155,,RAD`

. This problem can be solved if we change the reaction type of this quantity from `NQ` to `L` (amplitude or length) which allows a reaction product in SF4. This change is justified by the following relation between the scattering radius R' and bound atom scattering amplitude (length) $b_{\pm}$:

$$[A/(A+1)]|b_{\pm}| = R' - [(A+1)/A]\,[\hbar/(8m)^{1/2}]\,\Sigma_{i\pm}\,[(\Gamma_{n,i}/E_{0,i}^{3/2}) - i\,(\Gamma_{n,i}\Gamma_{n}/2E_{0,i}^{5/2})],$$

(c.f. Memo 4C-3/403). We make the following proposal in addition to Proposal 1:

Proposal 2: Change the reaction type of the scattering radius `,RAD` from `NQ` (nuclear quantity) to `L` (amplitude or length).

Another question is distinction between the scattering radius (`,RAD`) and potential scattering radius (`POT,RAD`). I *quickly* checked source articles to understand usage of `,RAD` in EXFOR Master:

Entry	Term seen in the source article (Must be checked by the originating centre!)

10051	potential scattering radius R'
10052	potential scattering radius R'
10561	effective radius
10714	effective radius
20119	(Source article unavailable.)
20124	(Source article unavailable)
20146	effective radius (rayon effectif) R'
20149	(Source article unavailable)
20676	(Source article unavailable)
20682	scattering radius (rayon de diffusion) R'
20683	scattering radius (rayon de diffusion) R'
20684	scattering radius (rayon de diffusion) R'
20685	scattering radius (rayon de diffusion) R'
20686	scattering radius (rayon de diffusion) R'
20687	scattering radius (rayon de diffusion) R'
20688	scattering radius (rayon de diffusion) R'
20859	potential scattering radius a
21769	spin dependent scattering length (cold neutrons)
22813	potential scattering radius R'
21980	potential scattering radius R'
22528	scattering length a_0
23003	potential scattering length R'
23060	?
23196	effective scattering radius R'
40594	(in Russian)
40981	(in Russian)
40991	(in Russian)
41099	coherent scattering length b_c
41170	potential scattering radius R'
41422	L-dependent scattering radius R_0' (l=0)

In addition to Proposal 2, we would like to make the following proposal:

Proposal 3: NNDC, NEA DB and CJD will inform other centres by the end of 2016 if we should distinguish quantities coded with `,RAD` from those coded with `POT,RAD`.

Appendix: List of nuclear quantities (NQ) in Dictionary 236

The following 5 quantities codes are currently defined with `NQ` in Dictionary 236:

- `,LD` (level density)
- `,LDP` (level density parameter)
- `,RAD` (scattering radius)
- `,SCO` (spin-cut-off factor)
- `,TEM` (nuclear temperature)

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