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**Memo CP-D/696**

**Date:** 12 May 2011
**To:** Distribution
**From:** N. Otsuka

**Subject:** **Thick target yield given in decay rate per charge (PRELIM.A070)**
**Reference:** Memo CP-D/631

In preliminary transmission PRELIM.A070, the following entries give thick target yields in dps/μA-h (`DPS/MUAHR`):

A0122, A0199, A0226, A0256, A0257, A0259, A0260, A0269, A0294
(P.P. Dmitriev, N.N. Krasnov *et al*. from Obninsk)
A0211, A0212, A0331
(G.Vakilova, S. Mukhammedov *et al*. from Tashkent)

First of all, I appreciate systematic addition of English translation information to `REFERENCE` of these entries, which helped my analysis a lot.

Among three yields currently defined in EXFOR, (1) "physical thick target yield" (`,TTY,,PHY`), (2) "production thick target yield" (`,TTY,,DT`) and (3) "saturated thick target yield" (`,TTY`) - , only the physical thick target yield can take dps/ μA-h (c.f. Eqs 2, 4 and 8 of Memo CP-D/631).

| **Quantity** | **Quantity code** | **Unit family** | **Unit (Example)** |
|---|---|---|---|
| Physical thick target yield | `,TTY,,PHY` | `TTT` | dps/μA-h, MBq/Coul. |
| Production thick target yield | `,TTY,,DT` | `TTY` | MBq/ μA |
| Saturation thick target yield | `,TTY` | `TTY` | MBq/ μA |

In PRELIM.A070, the quantity codes of above entries are changed from `,TTY` to `,TTY,,PHY` as expected from above the table. However I learned that the "yield" given in dps/μA-h (or MBq/ μA-h, MBq/Coulomb etc. belongs the unit family `TTT`) is not always the physical thick target yield:

If we obtain the production thick target yield $A_t$ after irradiation time $t$, the corresponding physical thick target yield $y$ is

$$y = A(t)\frac{\lambda}{1-e^{-\lambda t}}$$

. If irradiation time is enough shorter than the life-time of the product nuclide ($\lambda t << 1$), $y \sim A(t)/t$ (i.e. physical thick target gives the slope of $A(t)$ at $t$=0), and we can simply convert the production thick target yield to the physical thick target yield without correction due to decay during irradiation. But Sandor Takacs explained me

that this approximation has been wrongly sometimes applied even for short half-life products.

In the A0211 article [1], their "yield" is defined by above the equation, and we may use TTY,,PHY in PRELIM.A070. For other entries in PRELIM.A070, however, we should probably use another code when the definition of the "yield" is not clear from the article.

For EXFOR A0168 (not included in PRELIM.A060), yields in MBq/ μA-h are coded with ,TTY,,DT. In the original article [2], authors introduced the "physical thick target" with the equation and ,TTY,,PHY is more suitable than ,TTY,,DT.

In conclusion, I propose compilers to use ,TTY,,**(PHY)** instead of ,TTY,,PHY when data are given in dps/μA-h (or other unit codes belonging to the unit family TTT) but the definition of the quantity is not clear from the article. CAJaD may select more appropriate code for each entry. Probably sometimes decision may depend on each compiler as we have been experienced for decision of isomeric transition contribution M+ and (M).

Addition of the following new code to dictionaries should be considered if CAJaD applies ,TTY,,(PHY) to some entries in the final TRANS.A070.

**Dictionary 34 (Modifiers)**

| | |
|---|---|
| (PHY) | Uncertain if yield is for infinitesimal irradiation |

**Dictionary 236 (Quantities)**

| | |
|---|---|
| ,TTY,,(PHY) | Thick/thin target yield (activity) per induced charge<br>(Compilers uncertain if yield is for infinitesimal irradiation) |

In old dictionary (e.g., TRANS.9073 April 1997), we can see the unit family field is blank for DPS/MUAHR in dictionary 24. I think people could not find a good solution at that time.

I thank Sandor Takcs for his useful comments on this issue.

**Reference**

[1] G. Vakilova *et al*., Sov. Atom. Energy 55(1983)598 (EXFOR A0211)
[2] P.P. Dmitriev and G.A. Molin, INDC(CCP)-188 (1982) (EXFOR A0168)

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