

Dictionary 236 (Quantities) – M+,SIG,,RAB and question on RAB

(S.C. Yang, N. Otsuka, 2024-02-05, CP-D/1100)

The following new quantity code is proposed for compilation of 30856.003. This entry relates the cross section of Zr isotopes with the fast neutron. Zr-89 has both a short-lived metastable state Zr-89m ($t_{1/2}=4.161$ m) and a ground state Zr-89g ($t_{1/2}=78.41$ h). The Zr-89m decays to the unstable Zr-89g through IT process with the branching ratio of 93.77%. According to the current rule, M+ is used when there is no contribution from another nuclide and partial feeding via IT is not 100%. However, its combination with RAB is absent in the current Dictionary 236.

Dictionary 236 (Quantities)

M+, SIG, , RAB

Cross section times natural isotopic abundance, divided by abundance of target of first term of REACTION sum including isomeric transition

Quantity	Reaction Type	Dimension	Subentry
M+, SIG, , RAB	CS	CS	30856.003

Possible simplification of REACTION string so far coded with RAB

A REACTION string relevant to the RAB modifier always becomes a REACTION sum. For example,

```
REACTION ((40-ZR-90(N,2N)40-ZR-89-G,M+,SIG,,SPA) +
(40-ZR-91(N,3N)40-ZR-89-G,M+,SIG,,RAB/SPA) +
(40-ZR-92(N,4N)40-ZR-89-G,M+,SIG,,RAB/SPA))
```

for the $^{nat}\text{Zr}(n,x)^{89g}\text{Zr}$ cross section divided by the ^{90}Zr natural isotopic abundance ($a(^{90}\text{Zr})\sim 51\%$) when production from Zr isotopes other than ^{90}Zr is possible. An evaluator should construct the corresponding evaluated or theoretical cross sections by a theoretical elemental cross section divided by the ^{90}Zr natural isotopic abundance, namely, $\sigma[^{nat}\text{Zr}(n,x)^{89g}\text{Zr}] / a(^{90}\text{Zr})$. We propose simplification of the REACTION sum to

```
REACTION ((40-ZR-90(N,2N)40-ZR-89-G,M+,SIG,,OTH/SPA)
```

where OTH indicates presence of contribution from a Zr target isotope *other* than ^{90}Zr . This solution would be preferable for machine processing.