

LEXFOR “Neutron Yields”

(N. Otsuka, CP-D/798(Rev.), 2013-08-23)

A revision of the description on eta values in LEXFOR “Neutron Yield” is proposed below to give more clear definition for fast neutrons.

Eta (η)

Definition: The average neutron yield per nonelastic event for neutron-induced reactions:

$$\eta = \frac{\sum_i n_i \sigma_i}{\sum_i \sigma_i} = \frac{\sum_i n_i \sigma_i}{\sigma_{\text{nonelastic}}},$$

where the summation is taken over all nonelastic channels, and n_i is the average neutron multiplicity of the i -th nonelastic channel. For example, $n_i = 0$ for (n,γ) , (n,p) , (n,α) ; $=1$ for (n,n') , (n,np) , $(n,n\alpha)$; $=2$ for $(n,2n)$; $=\bar{\nu}$ for (n,f) .

For the **thermally** fissile isotopes, where fission and capture are, up to a certain threshold, the only nonelastic processes, η is defined as average neutron yield per absorption:

$$\eta = \bar{\nu} \frac{\sigma_f}{\sigma_{\text{abs}}} = \bar{\nu} \frac{\sigma_f}{\sigma_f + \sigma_\gamma}$$

REACTION Coding: **NON** or **ABS** in SF3, and **ETA** in SF6.

Units: a code from Dictionary 25 with the dimension YLD (e.g., PRT/REAC)

Examples:

(N, NON) , , ETA) η , in general

(N, ABS) , , ETA) η below (n,n') threshold

(N, ABS) , , ETA , , RES) η at resonance below (n,n') threshold

For further related quantity codes see Dictionary 236.

The use of ETA is not limited to fissile isotopes, and the following change is proposed for the expansion of the parameter code ETA:

Dictionary 32 (Parameters)

ETA Average neutron yield per nonelastic event ~~for fissile isotopes~~

References

- [1] P.P. Lebedev et al., J. Nucl. Energy A **11**(1959) 39.
- [2] E.R. Graves et al., Phys. Rev. **97** (1955) 1205.

The REACTION SF3 code for eta values must be NON when the incident neutron energy is higher than the inelastic threshold energy. I checked non-thermal eta values compiled in EXFOR entries, and found 21 data sets giving eta values for neutrons higher than the inelastic threshold and coded with ABS in SF3. It must be changed to NON if eta values are given.

Subentry	Target	En, max (eV)	Ex,1st (eV)
20002.006	Pu-239	3.0e+4	7.8e+3
20938.024	U-235	2.0e+2	7.7e+1
20938.029	U-235	2.0e+2	7.7e+1
21019.009	Th-232	7.0e+6	4.9e+4
21019.014	U-238	7.0e+6	4.5e+4
21019.026	U-238	7.0e+6	4.5e+4
21210.002	U-238	1.4e+7	4.5e+4
21750.006	Th-232	1.4e+7	4.9e+4
40350.008	U-233	9.0e+5	4.0e+4
40350.009	U-235	9.0e+2	7.7e+1
40350.010	Pu-239	9.0e+5	7.8e+3
40350.011	U-233	2.5e+5	4.0e+4
40350.012	U-235	3.0e+4	7.7e+1
40350.013	Pu-239	2.5e+5	7.8e+3
40385.004	U-235	8.8e+5	7.7e+1
40385.010	Pu-239	8.8e+5	7.8e+3
40639.003	Pu-239	1.4e+7	7.8e+3
40806.002	U-235	1.4e+7	7.7e+1
40806.004	U-238	1.4e+7	4.5e+4
40808.004	Pu-239	2.4e+4	7.8e+3
40808.007	U-235	2.4e+7	7.7e+1