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Memo CP-D/590

Date: 13 October 2009
To: Distribution
From: N. Otsuka

Subject: **Self-indication and raw data**
Reference: WP1999-7, CP-D/584

There are 6 entries (40876, 40884, 41151, 41290, 41394, 41426) compiled with `SIF` in SF6. All were measured by Yu. V. Grigor'ev *et al*. at Dubna and Obninsk reactors.

Because the definition of the self-indication is not very clear from the entry (which was proposed in WP1999-7) and it is closely related to transmission and reaction yield, I would propose to collect explanation of these quantities into a new LEXFOR entry "Transmission and Reaction Yield".

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Draft of new LEXFOR entry "Transmission and Reaction Yield")

Transmission and Reaction Yield

Definition: Transmission $T(E)$ and reaction yield $Y_x(E)$ are defined by

$$T(E) = \exp\left[-n_T \sigma_T(E)\right]$$

$$Y_x(E) = \left[1 - \exp\left(-n_T \sigma_T(E)\right)\right] \frac{\sigma_x(E)}{\sigma_T(E)} \quad (x = \text{capture, fission etc.})$$

, where, n_T is the sample thickness in nuclei/barn, $\sigma_T(E)$ and $\sigma_x(E)$ are the Doppler-broadened total cross section and cross section for the channel x.

REACTION coding:

`(…(N,TOT)),,TRN)`	Transmission
`(…(N,G)…),,TRN,,RYL)`	Capture yield

Independent variables:

Incident energy (`EN` etc.)
Sample thickness (`THICKNESS`)
Sample temperature (`TEMP`)

Units: `NO-DIM`

Usually these data are reduced from raw data as follows:

$$T = N_T \frac{C'_{in} - B'_{in}}{C'_{out} - B'_{out}} \qquad Y_x = N_x \frac{C'_x - B'_x}{C'_\varphi - B'_\varphi}$$

, where *in*, *out*, *r* and φ stand for sample-in, sample-out, reaction channel and beam flux measurement, N_T and N_x are normalization factors, and *C'* and *B'* denote count and background count corrected for dead time, respectively. In addition, reaction yield from incident particles scattered before inducing the reaction of type x should be subtracted from Y_x. Corrections applied to compiled data should be described under keyword `CORRECTION`. If appropriate corrections are not applied to data received by compilers, it should be indicated by `RAW` in SF8. (See **Raw Data**.).

In neutron time-of-flight measurements, the observed value broadened by resolution function is defined by

$$F(T) = \int R(T,E)\, f(E) dE$$

, where T is the channel number (e.g. time-of-flight channel) and R (T,E) is the resolution function (probability to find outgoing particle having E in T).

Transmission ratio and self-indication ratio

Transmission (ratio) T_g and self-indication (ratio) R_{gx} are defined as

$$T_g = \frac{\int_g \varepsilon_T(E)\exp[-n_T\sigma_T(E)]\varphi(E)dE}{\int_g \varepsilon_T(E)\varphi(E)\,dE} \sim \frac{\int_g \exp[-n_T\sigma_T(E)]dE/E}{\int_g dE/E}$$

$$R_{gx} = \frac{\int_g \varepsilon_x(E_\gamma)n_x\sigma_x(E)\exp[-n_T\sigma_T(E)]\varphi(E)dE}{\int_g \varepsilon_x(E_\gamma)n_x\sigma_x(E)\varphi(E)dE} \sim \frac{\int_g \sigma_x(E)\exp[-n_T\sigma_T(E)]dE/E}{\int_g \sigma_x(E)\,dE/E}$$

, where $\varepsilon_T(E)$ and $\varepsilon_x(E)$ give efficiencies detectors for transmission and reaction yield measurements, n_x gives the sample thickness of the thin reaction target, $\varphi(E)$ gives spectrum of incoming particles. Integration is performed over a given energy range of the energy group *g*. The approximation ~ is applied when the efficiencies are regarded as constants and the spectrum is proportional to 1/*E*. These ratios can be used to derive self-shielding factors in reactor physics [1,2].

REACTION coding:

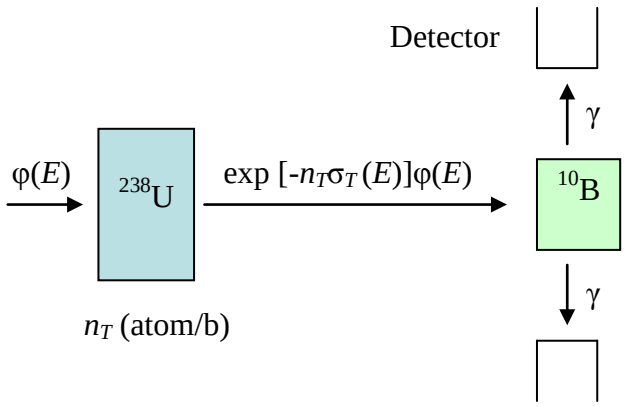
`(…(N,TOT)),,TRN,,SPA)`	Transmission (ratio)
`(…(N,G)…),,SIF,,SPA)`	Self-indication (ratio) for capture

Independent variables:

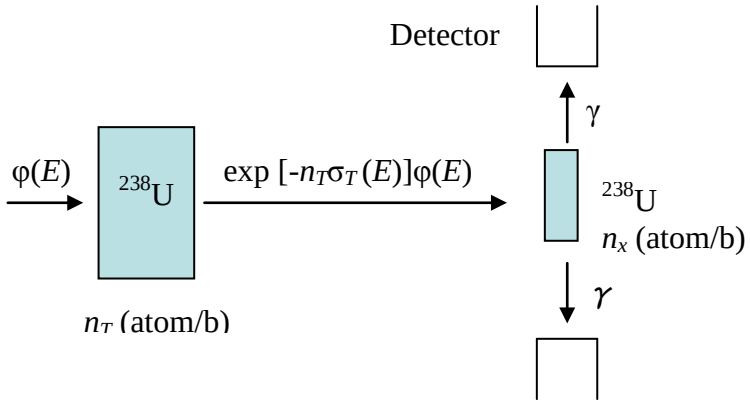
Upper and lower boundary of incident energy (`EN-MIN`, `EN-MAX`)
Sample thickness (`THICKNESS`)
Sample temperature (`TEMP`)

Units: `NO-DIM`

Spectrum should be explained under `INC-SPECT`.



(a) Transmission measurement for ^{238}U



(b) Self-indication measurement for ^{238}U

References

[1] H. Oigawa *et al*., J. Nucl. Sci. Technol. **28** (1991) 879
[2] T. Bakalov *et al*., Proc. of Int. Conf. on Nuclear Cross Sections for Technology, Knoxville, Tennessee, 22 - 26 Oct 1979, p692.