Cross section integral of photonuclear reaction (,INT,,BRS)

(N. Otsuka and V. Varlamov, 2022-01-15, Memo CP-D/1037)

This paper seeks an approval for revision of the description of the cross section integral (integrated cross section) in LEXFOR.

There has been an ambiguity in the choice of the modifier (BRS or BRA) for the cross section integral over a given incident energy range (integrated cross section) of a photonuclear reaction derived by integration of the cross sections unfolded from measured Bremsstrahlung spectrum averaged cross sections ("yield"). As BRA is for an incident energy dependent quantity averaged over a Bremsstrahlung spectrum, combination of BRA with INT looks inadequate. On the other hand, it would be still good to have distinction between the integrated cross section derived from (1) unfolded cross sections and (2) cross sections measured under (quasi-)monoenergetic photon sources.

We propose use of ,INT,,BRS for the cross section integral derived from unfolded cross sections. The following addition in LEXFOR "Cross sections" is proposed:

Cross sections

…

Cross Section Integral Over a Given Incident Energy Range (Integrated Cross Section)

Definition:

$$\int_{E_1}^{E_2} \sigma \; dE$$

REACTION Coding: `INT` in SF6.

Units: code from Dictionary 25 with the dimension `B*E` (*e.g.*, `MB*MEV`).

Example: `(92-U-235(N,F),,INT)`[4]

The energy limits are specified under the data-heading keywords `EN-MIN` and `EN-MAX`.

…

Compilation of such data is optional.

When integration was done for the cross sections obtained by unfolding of Bremsstrahlung spectrum averaged cross sections, BRS is coded in SF8.

Example: `(82-PB-208(G,N)82-PB-207,,INT,,BRS)`

The cross section integrated over the resonance is the **resonance area** and ARE is used instead of INT.

There are 70 entries providing datasets combining SF6=INT with SF8=BRA. Two of them are from NDS (G0008.002-003, G4020.002-020), one of them are from JCPRG (K2191.007-010). The rest of them are from CDFE (M0007 etc.).

G0008.002-003

The energy dependent (γ,sn) cross sections obtained by Penfold-Leiss plotted in Fig.1 of A.D.Bates et al., Phys.Rev.C 40(1989)506 have been integrated to obtain the cross section integrals compiled in these subentries.

UNW,INT,„BRS must replace ,INT,„BRA.

G4020.002-020

The authors expressed the activation rate for (γ,γ') excitation of the target nuclide to its isomer measured with the end point energy of E_0 by

$$A(E_0)=N_f/N_i/\Phi_0 = \Sigma_j\ (\sigma\Gamma)_{fj}\ F(E_j,E_0)$$

where Ni and N_f are the populations of resonances and metastable state, Φ_0 is the photon flux, $F(E_j,E_0)$ is for relative intensity of photon at E_j normalized such that its integration up to E_0 is 1. $(\sigma\Gamma)_{fj}$ is the cross section integral over the jth resonance. The cross section integral $\Sigma_j\ (\sigma\Gamma)_{fj}$ is not determined in this work, and the authors alternatively report

$$\Sigma_j\ (\sigma\Gamma)_{fj}\ F(E_j,E_0)/\ F(2.125\ \text{MeV}, E_0) = A(E_0)/F(2.125\ \text{MeV}, E_0)$$

as an "*effective* integrated cross section" considering all dominant resonances are above 2.125 MeV. Currently the quantity is expressed by ,INT,„BRA/FCT. However. the reported quantity cannot be related with the cross section integral by a simple constant by users.

We suggest deletion of these datasets.

K2191.007-010

The authors unfolded the measured Bremsstrahlung spectrum averaged cross sections (Figs.2 to 6 of A. Masaike, J. Phys. Soc. Jpn. 19(1964)427) by Penfold-Leiss, and have integrated the unfolded cross sections to obtain the cross section integrals compiled in K2191.007-010.

,INT,„BRS must replace ,INT,„BRA.

The excitation functions in Figs.9 and 10 must be digitized and added to the EXFOR entry though these figures are missing in the pdf file distributed from the publisher.

Area M entries

M0597.008-013 and M0614.006-007 have been done in TRANS.M116. The rest 65 entries will be assessed and revised.