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Memo CP-D/592

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To: Distribution
From: N. Otsuka, R Capote Noy

Subject: Prompt gamma production below threshold of 2nd level excitation

If we consider reactions where mass numbers of both projectile and outgoing particle are 1, discrete gamma production cross sections are usually coded as follows:

If SF1=SF4 (inelastic scattering),

(SF1 (SF2 , INL) SF4 , PAR , SIG , G) with γ energy under heading E (1a)

, else

(SF1 (SF2 , SF3) SF4 , PAR , SIG , G) with γ energy under heading E (1b)

.

If the part of the data table is for incident energy below than threshold of the 2nd level excitation, this part can be also expressed by the following codes:

If SF1=SF4 (inelastic scattering),

(SF1 (SF2 , INL) SF4 , , SIG) (2a)

, else

(SF1 (SF2 , SF3) SF4 , PAR , SIG) with the 1st level energy under E-LVL (2b)

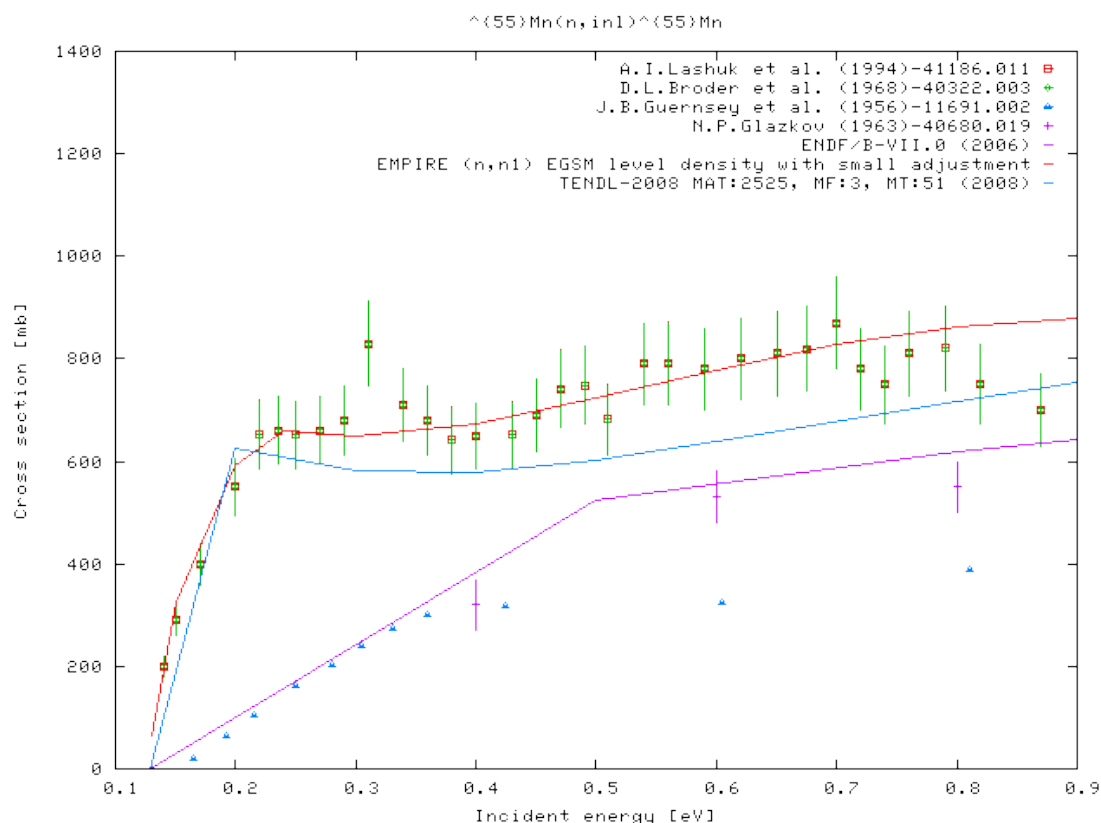
.

The expression (2) is a more general quantity than (1) and convenient for end users. For example, the current translation program from the EXFOR to C4 format does not translate gamma production cross sections (1) to the C4 format and therefore evaluators have not paid attention to the gamma production cross sections. We would recommend to use REACTION code (2) (after separation of the relevant part from the data table if necessary) when all or a part of measured incident energy range is lower than the threshold of 2nd level excitation of the reaction product. Note that it is generally asked not to split a data set by threshold energies. See also the LEXFOR entry "Threshold".

Example: $^{55}\text{Mn}(n,\text{inl})^{55}\text{Mn}$ cross section below 0.9 MeV

$E_{\text{exc}}(^{55}\text{Mn}) = 0 \text{ keV } (5/2^-), 126 \text{ keV } (7/2^-), 984 \text{ keV } (9/2^-), \dots$

(Huo Junde, Nucl.Data Sheets **109**,787,2008)



Author	EXFOR	REACTION (SF6-8)	Secondary energy (keV)
A.I.Lashuk <i>et al.</i> (1994)	41186.011	PAR, SIG, G	E=126
D.L.Broder <i>et al.</i> (1968)	40322.003	PAR, SIG, G	E=130
J.B.Guernsey <i>et al.</i> (1956)	11691.002	PAR, SIG, G	E=130
N.P.Glazkov (1963)	40680.019	, SIG	-
N.P.Glazkov (1963)	40680.020	PAR, SIG	E=128 Not shown in the figure. (=40680.019)
Ju.G.Degtjarev <i>et al.</i> (1971)	40278.004	PAR, SIG= PAR, SIG, G	E-LVL=126, 208, 308

In the current EXFOR database, three subentries (40680.019=40680.020, 40278.004) are coded without G in SF7. Evaluated cross section in JENDL-3.3 (=JEFF-3.1, ENDF-B/VII.0) agrees with them (except 40278.004 above 0.5 MeV). Theoretical calculations with the EMPIRE code (undertaken within a new evaluation effort) show calculated inelastic cross section (Hauser Feshbach + width fluctuation method) to be much higher than Glazkov's data, in agreement with (n,n' γ) measurements by Lashuk *et al.* Similar trend can be seen in TENDL-08 library obtained by TALYS code.

Actions to CJD:

- 1) 41186.All: Search data sets from the same measurement in other area 4 entries.
- 2) 40278.004: Check suspicious level energies (208 keV, 308 keV). "Old" levels?

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