

Prompt Fission Cross Section (PR,SIG)

(N. Otsuka, 2012-10-11. CP-D/767)

Delayed fission:

Fission through a spontaneous fissioning short-lived isomer as an intermediate state, e.g., $^{243}\text{Am}(n,2n)^{242\text{m}2}\text{Am}(sf)$

Prompt fission:

Fission without such an isomer as an intermediate state, e.g., $^{243}\text{Am}(n,f)$

During checking of PRELIM.O049, the quantity code PR,SIG (prompt fission cross section) defined in dictionary 236 becomes questionable for me.

The prompt and delayed fission cross sections were discussed in the relation with formation of spontaneous fissioning isomers e.g., $^{242\text{m}2}\text{Am}$ (14 msec) which were actively studied by G.N. Flerov (JINR) et al. in 1960s. The authors often report the ratio of the delayed fission cross section to the prompt fission cross section. They try to distinguish delayed fission from the prompt fission in their terminology. In EXFOR, however, there is no DL,SIG (delayed fission cross section) in the dictionary. Also PR,SIG (prompt fission cross section) is *not* seen in neutron reaction data in EXFOR.

An example of neutron-induced spontaneous fissioning isomer production is seen EXFOR 40504.009.2:

$(95\text{-AM-243}(N,2N)95\text{-AM-242-M2},,SIG) / (95\text{-AM-243}(N,F),,SIG)$

Though spontaneous fission of $^{242\text{m}2}\text{Am}$ was observed, the numerator is treated as the production cross section of $^{242\text{m}2}\text{Am}$. (*i.e.*, EXFOR *assumes* that the branching ratio is 100% for the spontaneous fission of $^{242\text{m}2}\text{Am}$.)

For charged-particle induced reaction, PR,SIG is coded in five entries (EXFOR B0007, B0011, B0155, O0518, O0701). I do not understand why the fission cross sections in EXFOR O0518 and O0701 are treated as prompt fission cross sections. Arjan Koning (the 2nd author of the O0518 article) notified me that the compiler is wrong and PR can be removed in EXFOR O0518. I have the same question for EXFOR O0701, but it cannot be solved easily because the entry is compiled from a thesis.

In the other 3 entries (EXFOR B0007, B0011, B0155), PR,SIG are coded for (p,f) and (α ,f) prompt fission in the relation with production of spontaneous fissioning isomers $^{237\text{m}1}\text{Pu}$ (80 nsec), $^{237\text{m}2}\text{Pu}$ (1 μ sec), $^{237\text{m}}\text{Np}$ (45 nsec) as well as $^{240\text{g}}\text{Cm}$ (26 d), $^{241\text{g}}\text{Cm}$ (35 d) through (p,2n) or (α ,2n) reactions. Furthermore production of $^{240\text{m}}\text{Am}$ (0.9 msec) and $^{242\text{m}2}\text{Am}$ (14 msec) through (d,2n) reactions are newly compiled with (d,f) prompt fission cross sections in EXFOR O2041 and O2042 in PRELIM.O049.

Probably compilers opt PR,SIG than ,SIG when authors explain the measured prompt fission cross section as “prompt fission cross section” explicitly. Do we really indicate “prompt” by PR? Usually delayed fission neutron cross section is 0.1% or less of the total fission cross section. Therefore we could assume

$(---(-,F),PR,SIG) \sim (---(-,F),,SIG)$

and make PR,SIG obsolete.