

Isomeric Flag –G for DECAY-DATA

(N. Otsuka, 2015-04-09, Memo CP-D/872,
O. Schwerer, 2015-04-13, Memo CP-C/440)

Memo CP-D/872

The current EXFOR Formats Manual explains that the use of the isomeric flag –G is optional in the nuclide field of DECAY-DATA. I propose to treat it as obligatory due to the following reason:

Authors often do not show existence of the isomeric state explicitly (e.g., ^{198}Ag instead of $^{198\text{g}}\text{Ag}$), and consequently the compiler may not realize existence of its metastable state. It does not create a problem in compilation in many cases. However I observe sometimes the compiler overlook the existence of the metastable state and it results in a wrong REACTION coding.

Example (D6212.007 in PRELIM.D090)

The $^{45}\text{Sc}(^{16}\text{O},x)^{52\text{g}}\text{Fe}$ (8.3 h) cross section is compiled from Table 1 and Fig.3 of Avinash Agarwal et al., EPJ Conf. Ser. **38**(2012)17001. There is an isomer (46 sec, IT ~ 0%), and therefore the REACTION and DECAY-DATA should be

REACTION (21-SC-45 (8-O-16, X) 26-FE-52-G, CUM, SIG)

DECAY-DATA (26-FE-52-G, 8.3HR)

where –G of DECAY-DATA is now optional in our current rule. However the compiler did not know about existence of the 46 sec metastable state and its isomeric transition probability, and provided the following wrong REACTION code:

REACTION (21-SC-45 (8-O-16, X) 26-FE-52, CUM, SIG)

DECAY-DATA (26-FE-52, 8.3HR)

This problem may be avoided if the compiler is always required to add –G in DECAY-DATA whenever a metastable state exists.

Table 1. List of identified Evaporation Residues (ERs) and their spectroscopic data used in the present study

Reaction	half-life ($T_{1/2}$)	Spin-parity (J^P)	E_γ KeV	I^γ %
^{57}Ni (p3n)	36.0 d	$3/2^-$	1376.8	77.6
^{56}Ni (p4n)	6.07 d	0^+	158.7	98.8
			480.0	36.5
^{57}Co (2p2n)	271.79 d	$7/2^-$	121.2	85.5
^{56}Co (α n)	78.76 d	4^+	846.6	100.0
			1036.9	14.0
			1237.6	67.6
^{55}Co (α 2n)	17.56 h	$7/2^-$	477.2	20.3
			932.2	75.0
			1407.4	16.5
^{52}Fe (α 4pn)	8.27 h	0^+	168.7	99.2

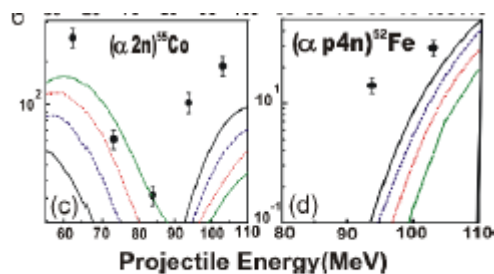


Fig. 3. Experimentally measured and theoretically calculated EFs for different residues populated via (2p2n), (α ,n), (α ,2n) and (α ,p4n) channels in the $^{16}\text{O} + ^{43}\text{Sc}$ system at ≈ 50 -105 MeV. The other details are same as in figure 2.

Another good example is seen in PRELIM.3169 (31714.047, 31750.029, 31570.034, 31750.036). I can check every new preliminary tape by a small program for detection of missing –G, and can ask the originating centre addition of -G to the DECAY-DATA. (I think CHEX also made an error or warning message when I started EXFOR compilation.)

Memo CP-C/440

In memo CP-D/872 it is proposed to make the use of the isomeric flag -G in DECAY-DATA obligatory for all cases where the nuclide has a metastable state. This request is supported by valid examples where indeed -G should be added.

(Note however that in the first example, -G is missing already in REACTION SF4, which is a mistake also according to current rules. In this particular case, the absence of -G in DECAY-DATA may be a consequence of the mistake in the REACTION coding.)

Before deciding to make -G obligatory in DECAY-DATA in all cases where a metastable state exists, I suggest to consider also the following:

- Years ago, we already had that rule: -G had to be used in DECAY-DATA always when the nuclide has a metastable state. This led to a very high number of requests for corrections in Exfor, as often compilers followed the practice of authors who do not mention that it is the ground state when the existence of a metastable state has no relevance to their experiment or its results. After analyzing this situation, it was found that in such cases -G in DECAY-DATA is not necessary and therefore need not be obligatory.

- Certainly there are cases where -G should be used in DECAY-DATA, such as the examples given in CP-D/872. The present rule, saying that it is not obligatory, should not be (mis)interpreted to mean that it is never needed.

- If -G in DECAY-DATA becomes obligatory again, the question arises how many requests for retroactive corrections this will generate. Some of these corrections will be justified, but others, perhaps many, will look to many as cosmetic corrections. How many additions to the Feedback List this new rule will generate?

- Perhaps it could suffice to introduce a clarification which is less strict. Whenever the existence of a metastable state has significance for the experiment and/or the compiled result, -G must be given. This will always be the case when -G appears in the REACTION code; but certainly also in other cases.