WP2023-19

Comparison of REACTION SF4 isomeric flag against NUBASE2020

(N. Otsuka, 2022-08-26, Memo CP-D/1052(Rev.))

As a test of a new Dictionary 227 produced from Nubase2020 (F.G. Kondev et al., Chin. Phys. **C45**(2021)030001), I checked presence of an isomeric state coded under REACTION SF4 (including ratio like M/G) of EXFOR Master 2020-08-03 against the new Dictionary 227. I found 306 cases where an isomeric state coded in SF4 is not defined in the new Dictionary 227. Three most typical isomeric states are 49-IN-116-M (45 cases), 79-AU-196-M (32 cases) and 73-TA-178-M (24 cases).

Suggestions of corrections are appended to this memo. As usual, compilers are expected to check the source article and decay scheme before correction of the EXFOR entry by themselves. (I am not a decay data expert and your feedback to my comments is welcome!)

Some general remarks:

- There are still many cross-section datasets where a half-life is coded under HL, HL1 etc. (309 such datasets in current EXFOR Master!). This disturbs use of decay data!

- Suggestions are mainly done only when (1) its half-life is coded, or (2) the nuclide does not have a metastable state. One may guess which metastable is considered even if the half-life is not given by the authors (e.g., 79-AU-196-M is most probably for the M2 state (9.6 hr) rather than the M1 state (8.1 sec) considering actual measurements). But I decided not to make such suggestions and leave such decision to users.

- Suggestions cannot be unique when the order of the ground state and metastable state is uncertain in NUBASE (flagged by * in NUBASE). In this case, I put all options with the first option following ordering in NUBASE.

  Example: ^{178}Ta production cross sections measured with the 2.4 hr state activity most probably includes the 290 ms IT decay (100%) contribution. NuBase2020 indicates the 2.4 hr state as the ground state, but it also indicates ordering is uncertain. Therefore, my suggestion of REACTION SF4 isomeric flag attached to `73-TA-178` is "`G+M1` (or `M1+M2`)".

- Some (mainly) heavy nuclides have two very short-lived states (typically unstable against alpha decay or spontaneous fission). They are typically measured separately, but we can define only their ground state in Dictionary 227 because of the $T_{1/2}$=0.1 sec boundary.

  Example: ^{217}Ac 69 nsec state (Ex=0 MeV) is defined in Dictionary 227 while its 740 nsec state (Ex=2012 keV) cannot be defined in Dictionary 227 even if the higher state has longer half-life. N.B. Nuclide Wallet Cards 2011 extends the boundary from 0.1 sec to 1 msec for some nuclides which decay by spontaneous fission, alpha or proton emission and I see its reason.

- The Formats Manual explains an isomeric flag G is "for ground state (of a nucleus which has a metastable state)". Here I assumed "metastable state" includes quasi-metastable states in this assessment.

REACTION SF4 isomeric state not defined in Dictionary 227 converted from Nubase2020

- SF4 (code): REACTION SF4
- SF4 (nuclide): An isomer coded in REACTION (SF4)
- HL in X4: Half-life coded under DECAY-DATA (or HL, HL1, HL2 if the value is followed by *)
- Iso (ND): Number of isomeric states of the nuclide defined in Dictionary 227 (0: ground state only, M: one metastable state, M1M2: two metastable state)
- Ord (ND): Isomeric state ordering uncertain
- X4Com: Presence of a comment in EXFOR regarding currently unknown isomeric state (not exhaustive)

Dataset #	SF4 (code)	SF4 (nuclide)	HL in X4	Iso (ND)	Ord (ND)	X4Com	Suggestion (REACTION)	Suggestion (DECAY-DATA)	Remark
F1329.002	102-NO-250-G	102-NO-250-G	5.1MICROSEC	0					Short-lived SF quasi-metastable state exists.
E2438.002	104-RF-261-M1	104-RF-261-M1	68.SEC	M	*		SF4: M1 -> M	M1 -> M	
E2324.003	104-RF-261-M1/M2	104-RF-261-M1	68.SEC	M	*		SF4: M1/M2 -> M/G	M1 -> M	
E2324.003	104-RF-261-M1/M2	104-RF-261-M2	1.9SEC	M	*		SF4: M1/M2 -> M/G	M2 -> G	
E2438.006	104-RF-261-M1+M2	104-RF-261-M1	68.SEC	M	*		Delete -M1+M2.	M1 -> M	
E2438.006	104-RF-261-M1+M2	104-RF-261-M2	1.9SEC	M	*		SF4: Delete -M1+M2.	M2 -> G	
E2324.002	104-RF-261-M2	104-RF-261-M2	1.9SEC	M	*		SF4: M2 -> G	M2 -> G	
E2438.003	104-RF-261-M2	104-RF-261-M2	1.9SEC	M	*		SF4: M2 -> G	M2 -> G	
E2371.002	106-SG-265-M1	106-SG-265-M1	8.5SEC	M	*		SF4: M1 -> G	M2 -> G	
E2371.004	106-SG-265-M1+M2	106-SG-265-M1	8.5SEC	M	*		SF4: Delete -M1+M2.	M2 -> G	
E2371.004	106-SG-265-M1+M2	106-SG-265-M2	14.4SEC	M	*		SF4: Delete -M1+M2.	M2 -> M	
E2371.003	106-SG-265-M2	106-SG-265-M2	14.4SEC	M	*		SF4: M2 -> M	M2 -> M	
C1735.002	107-BH-262-G	107-BH-262-G	84.MSEC	0					Short-lived alpha quasi-metastable state exists.
F1273.002	114-FL-285-M	114-FL-285-M	0.15SEC	0			SF4: Delete -M.	Delete -M.	
F1336.002	114-FL-285-M	114-FL-285-M		0			SF4: Delete -M.		
11365.002	11-NA-24-G	11-NA-24-G	15.HR*	0			SF4: Delete -G.	Move HL=15.HR from COMMON.	
C0700.005	11-NA-24-G	11-NA-24-G		0			SF4: Delete -G.		
P0067.005	11-NA-24-G	11-NA-24-G		0			SF4: Delete -G.		
P0124.002	11-NA-24-G	11-NA-24-G		0			SF4: Delete -G.		

T0131.019	11-NA-24-G	11-NA-24-G	15.0HR	0		SF4: Delete -G.	Delete -G.	
T0131.044	11-NA-24-G	11-NA-24-G	15.0HR	0		SF4: Delete -G.	Delete -G.	
10142.002	13-AL-30-M	13-AL-30-M	72.5SEC	0	Y			
21846.018	13-AL-30-M	13-AL-30-M	72.5SEC	0	Y			
F1232.005	21-SC-46-G+M1	21-SC-46-M1		M		SF4: Delete -G+M1.		
F1232.010	21-SC-46-G+M1	21-SC-46-M1		M		SF4: Delete -G+M1.		
F1305.003	21-SC-46-G+M1	21-SC-46-M1		M		SF4: Delete -G+M1.		
F1232.006	27-CO-58-G+M1	27-CO-58-M1		M		SF4: Delete -G+M1.		
F1232.011	27-CO-58-G+M1	27-CO-58-M1		M		SF4: Delete -G+M1.		
F1232.003	27-CO-60-G+M1	27-CO-60-M1		M		SF4: Delete -G+M1.		
F1232.008	27-CO-60-G+M1	27-CO-60-M1		M		SF4: Delete -G+M1.		
11740.017	27-CO-64-M	27-CO-64-M	2.0MIN	0	Y			OUTDT coded.
22338.024	29-CU-70-M	29-CU-70-M		M1,M2				
O0348.055	30-ZN-73-G	30-ZN-73-G	23.5SEC	0		SF4: Delete -G.	Delete -G.	
V1001.267.2	32-GE-71-G	32-GE-71-G	11.8D	0				Quasi-metastable state is considered.
10835.004.1	33-AS-74-G	33-AS-74-G	17.5D	0	Y			
O1377.003.3	33-AS-74-G	33-AS-74-G		0	Y			
10835.004.2	33-AS-74-M	33-AS-74-M	8.SEC	0	Y			
O1377.003.2	33-AS-74-M	33-AS-74-M		0	Y			
O1377.002	33-AS-74-M/G	33-AS-74-G		0	Y			
O1377.002	33-AS-74-M/G	33-AS-74-M		0	Y			
O1377.003.1	33-AS-74-M/G	33-AS-74-G		0	Y			
O1377.003.1	33-AS-74-M/G	33-AS-74-M		0	Y			
21107.017	33-AS-78-G	33-AS-78-G	91.MIN	0	Y			
21107.016	33-AS-78-M	33-AS-78-M	6.MIN	0	Y			
21107.019	33-AS-78-M/G	33-AS-78-G		0	Y			
21107.019	33-AS-78-M/G	33-AS-78-M		0	Y			
21413.002	33-AS-78-M/G	33-AS-78-G	90.MIN	0	N			
21413.002	33-AS-78-M/G	33-AS-78-M	6.1MIN	0	N			

G0001.005	34-SE-73-M1/G	34-SE-73-M1	38.9MIN	M		SF4: M1/G -> M/G	M1 -> M	
G0001.004	38-SR-85-M1/G	38-SR-85-M1	69.5MIN	M		SF4: M1/G -> M/G	M1 -> M	
14211.003	39-Y-88-G	39-Y-88-G		0		(ok)		Quasi-metastable state is considered.
21300.016	39-Y-88-G	39-Y-88-G	106.6D*	0		SF4: Delete -G.	Move HL=106.6D from COMMON.	"g" not mentioned in the article.
10493.008.G	39-Y-88-G	39-Y-88-G	107.D	0				Quasi-metastable state is considered.
10493.011	39-Y-88-L1+L2/G	39-Y-88-G	107.D	0				Quasi-metastable state is considered.
P0008.002	39-Y-88-M	39-Y-88-M		0		SF4: M -> L	Add T1/2=14.5 msec.	
30101.009	39-Y-88-M/G	39-Y-88-G		0	N			
30101.009	39-Y-88-M/G	39-Y-88-M		0	N			
22017.002	39-Y-97-M/T	39-Y-97-M		M1,M2				
23810.002	39-Y-97-M/T	39-Y-97-M		M1,M2		SF4: M/T -> M1+M2/T		Fraction of high-spin (92+) isomer
O2429.004	39-Y-97-M/T	39-Y-97-M		M1,M2				
O2429.010	39-Y-97-M/T	39-Y-97-M		M1,M2				
G0001.003	40-ZR-89-M1/G	40-ZR-89-M1	4.18MIN	M		SF4: M1/G -> M/G	M1 -> M	
11590.053	41-NB-92-M2	41-NB-92-M2	13.HR	M	Y			OUTDT coded.
G0001.002	42-MO-91-M1/G	42-MO-91-M1	65.5SEC	M		SF4: M1/G -> M/G	M1 -> M	
V1001.408.1	43-TC-100-G	43-TC-100-G	15.8SEC	0		Delete -G.	Delete G.	
21976.038	47-AG-116-M	47-AG-116-M	10.5SEC	M1,M2		SF4: M -> M2	M -> M2	
O0830.004	47-AG-116-M/G	47-AG-116-M		M1,M2				
A0272.002	49-IN-109-G/M	49-IN-109-M	1.3MIN	M1,M2		SF4: G/M -> G+M2/M1		M1 coded in DECAY-DATA
A0335.012	49-IN-109-G/M	49-IN-109-M		M1,M2				
A0335.013	49-IN-109-G/M	49-IN-109-M		M1,M2				
D4069.002	49-IN-109-G/M	49-IN-109-M	1.34MIN	M1,M2		SF4: G/M -> G+M2/M1	M -> M1	
O1378.002	49-IN-109-G/M	49-IN-109-M	1.34MIN	M1,M2		SF4: G/M -> G+M2/M1	M -> M1	
C2602.003.1	49-IN-109-M	49-IN-109-M		M1,M2				
A0278.005	49-IN-109-M/T	49-IN-109-M		M1,M2				
30638.004	49-IN-113-M1	49-IN-113-M1	99.47MIN	M		SF4: M1 -> M	M1 -> M	
30641.013	49-IN-113-M1	49-IN-113-M1	99.48MIN	M		SF4: M1 -> M	M1 -> M	
30322.012.2	49-IN-114-M1	49-IN-114-M1	2.5SEC	M	Y			

M0704.002.2	49-IN-114-M1/G	49-IN-114-M1	43.MSEC	M	M1/G -> L/G	M1 -> L	
21717.002	49-IN-114-M1+M2	49-IN-114-M1	50.0D	M	SF4: M1 -> M	M1 -> M	
21717.003	49-IN-114-M1+M2	49-IN-114-M1	49.0D	M	SF4: M1 -> M	M1 -> M	
12609.002	49-IN-114-M2	49-IN-114-M2	42.MSEC	M	SF4: M2 -> L	M2 -> L	
F0937.008	49-IN-116-G/M	49-IN-116-M		M1,M2			
11450.031	49-IN-116-M	49-IN-116-M	54.MIN	M1,M2	SF4: M -> M1+M2	M -> M1	
11830.002	49-IN-116-M	49-IN-116-M	54.MIN	M1,M2	SF4: M -> M1+M2	M -> M1	
11975.010	49-IN-116-M	49-IN-116-M	54.MIN*	M1,M2	SF4: M -> M1+M2	Move HL=54.MIN from COMMON.	
12866.099	49-IN-116-M	49-IN-116-M	3.774E-02D	M1,M2	SF4: M -> M1+M2	M -> M1	
13860.045	49-IN-116-M	49-IN-116-M	54.MIN	M1,M2	SF4: M -> M1+M2	M -> M1	
20229.004	49-IN-116-M	49-IN-116-M	54.MIN*	M1,M2	SF4: M -> M1+M2	Move HL=54.MIN from COMMON.	
20550.002	49-IN-116-M	49-IN-116-M	54.MIN*	M1,M2	SF4: M -> M1+M2	Move HL=54.MIN from COMMON.	
20633.004	49-IN-116-M	49-IN-116-M	54.MIN	M1,M2	SF4: M -> M1+M2	M -> M1	
20649.002	49-IN-116-M	49-IN-116-M	54.12MIN*	M1,M2	SF4: M -> M1+M2	Move HL=54.12 MIN from COMMON.	
20649.005	49-IN-116-M	49-IN-116-M	54.12MIN*	M1,M2	SF4: M -> M1+M2	Move HL=54.12 MIN from COMMON.	
21891.003	49-IN-116-M	49-IN-116-M	54.MIN	M1,M2	SF4: M -> M1+M2	M -> M1	
22234.005	49-IN-116-M	49-IN-116-M	54.MIN	M1,M2	SF4: M -> M1+M2	M -> M1	
23491.012	49-IN-116-M	49-IN-116-M		M1,M2			
30265.013	49-IN-116-M	49-IN-116-M		M1,M2			
30268.008	49-IN-116-M	49-IN-116-M		M1,M2			
30452.003	49-IN-116-M	49-IN-116-M		M1,M2			
30759.002	49-IN-116-M	49-IN-116-M		M1,M2			
31003.006	49-IN-116-M	49-IN-116-M	2.16SEC	M1,M2	SF4: M -> M2	M1 -> M2	
31237.003	49-IN-116-M	49-IN-116-M	54.MIN	M1,M2	SF4: M -> M1+M2	M -> M1	
31712.012	49-IN-116-M	49-IN-116-M		M1,M2			
33092.002	49-IN-116-M	49-IN-116-M	54.29MIN	M1,M2	SF4: M -> M1+M2		M1 coded in DECAY-DATA
40421.019	49-IN-116-M	49-IN-116-M	54.0MIN	M1,M2	SF4: M -> M1+M2	M -> M1	
40944.002	49-IN-116-M	49-IN-116-M		M1,M2			
20643.055.1	49-IN-116-M	49-IN-116-M	54.MIN	M1,M2	SF4: M -> M1+M2	M -> M1	

31099.005.2	49-IN-116-M	49-IN-116-M		M1,M2				
31472.004.2	49-IN-116-M	49-IN-116-M		M1,M2				
A0931.196	49-IN-116-M	49-IN-116-M		M1,M2				
A0931.314	49-IN-116-M	49-IN-116-M		M1,M2				
A0931.440	49-IN-116-M	49-IN-116-M		M1,M2				
C0488.020	49-IN-116-M	49-IN-116-M		M1,M2				
C0488.092	49-IN-116-M	49-IN-116-M		M1,M2				
D0467.005	49-IN-116-M	49-IN-116-M	54.29MIN	M1,M2		SF4: M -> M1+M2	M -> M1	
D4231.012	49-IN-116-M	49-IN-116-M	54.29MIN	M1,M2		SF4: M -> M1+M2	M -> M1	
D6006.025	49-IN-116-M	49-IN-116-M	54.29MIN	M1,M2		SF4: M -> M1+M2	M -> M1	
D6046.023	49-IN-116-M	49-IN-116-M	54.15MIN	M1,M2		SF4: M -> M1+M2	M -> M1	
D6060.025	49-IN-116-M	49-IN-116-M	54.29MIN	M1,M2		SF4: M -> M1+M2	M -> M1	
D6077.018	49-IN-116-M	49-IN-116-M	54.29MIN	M1,M2		SF4: M -> M1+M2	M -> M1	
K2027.147	49-IN-116-M	49-IN-116-M	54.15MIN	M1,M2		SF4: M -> M1+M2	M -> M1	
O0841.035	49-IN-116-M	49-IN-116-M		M1,M2				
O1586.003	49-IN-116-M	49-IN-116-M		M1,M2				
V0102.230	49-IN-116-M	49-IN-116-M		M1,M2				
K2027.261	49-IN-116-M/G	49-IN-116-M		M1,M2		SF4: M/G -> M1+M2/G		
K2027.270	49-IN-116-M/G	49-IN-116-M		M1,M2		SF4: M/G -> M1+M2/G		
M0704.003.1	49-IN-116-M/G	49-IN-116-M	54.1MIN	M1,M2		SF4: M/G -> M1+M2/G	M -> M1	
30388.005	49-IN-116-M/T	49-IN-116-M	54.0MIN	M1,M2		SF4: M/T -> M1+M2/T		M1 coded in DECAY-DATA
30202.014	49-IN-118-M	49-IN-118-M		M1,M2	*			
O0841.036	49-IN-118-M	49-IN-118-M		M1,M2	*			
20540.013	49-IN-120-M	49-IN-120-M	3.2SEC	M1,M2	*	SF4: M -> G	M -> G	
22415.016	49-IN-120-M	49-IN-120-M	44.4SEC	M1,M2	*			
40798.005	49-IN-120-M	49-IN-120-M	51.SEC	M1,M2	*			
12003.004	49-IN-120-M/G	49-IN-120-M	44.SEC	M1,M2	*			
O0320.027	51-SB-120-M1	51-SB-120-M1		M	*			
11274.083	51-SB-124-M	51-SB-124-M	20.MIN	M1,M2		SF4: M -> M2	M -> M2	

11997.002	51-SB-124-M	51-SB-124-M	1.3MIN	M1,M2			SF4: M -> M1. SF5: Add (M).	M -> M1	T1/2(M1)<T1/2(M2)
31080.008	51-SB-124-M	51-SB-124-M	21.3MIN	M1,M2			SF4: M -> M2	M -> M2	
O0562.006.2	51-SB-124-M	51-SB-124-M		M1,M2					
A0950.098	51-SB-124-M/G	51-SB-124-M		M1,M2					
O2028.008	51-SB-124-M/G	51-SB-124-M	20.2MIN	M1,M2			SF4: M/G -> M2/G or M2/G+M1?	M -> M2	IT=75% for the m1 state
O2028.009	51-SB-126-G/M	51-SB-126-M	19.0MIN	M1,M2			SF4: G/M -> G/M1+M2	M -> M1	
30286.008	51-SB-126-M	51-SB-126-M	1.9000E+01MIN	M1,M2			SF4: M -> M1+M2	M -> M1	
31563.009	51-SB-126-M	51-SB-126-M	19.03MIN	M1,M2			SF4: M -> M1+M2	M -> M1	
40029.011.1	51-SB-126-M	51-SB-126-M	19.1MIN	M1,M2			SF4: M -> M1+M2		M1 in DECAY-DATA
C0710.006	51-SB-126-M	51-SB-126-M	18.7MIN	M1,M2			SF4: M -> M1+M2	M -> M1	
O0562.009.2	51-SB-126-M	51-SB-126-M		M1,M2					
G0070.007	51-SB-126-M/T	51-SB-126-M		M1,M2					
41163.011	51-SB-130-M1	51-SB-130-M1	6.3MIN	M			SF4: M1 -> M	M1 -> M	
41163.012	51-SB-130-M1	51-SB-130-M1	40.0MIN	M			SF4: M1 -> G	M1 -> G	
O0348.026	51-SB-132-M1	51-SB-132-M1	4.2MIN	M			SF4: M1 -> M	M1 -> M	
12020.002	53-I-126-M	53-I-126-M	2.6HR	0		Y			
22637.064	63-EU-150-M1	63-EU-150-M1	12.55HR	M			SF4: M1 -> M	M1 -> M	
10783.003	64-GD-155-L/G	64-GD-155-G		0					Quasi-metastable state is considered.
D4267.005	65-TB-154-M	65-TB-154-M	22.7HR	M1,M2	*				
31565.002	65-TB-156-M	65-TB-156-M	5.0HR	M1,M2			SF4: M -> M2	M -> M2	
A0904.047	67-HO-160-M	67-HO-160-M	5.02HR	M1,M2			SF4: M -> M1	M -> M1	
A0904.237	67-HO-160-M	67-HO-160-M	5.02HR	M1,M2			SF4: M -> M1	M -> M1	
D6196.010	67-HO-160-M	67-HO-160-M	5.02HR	M1,M2			SF4: M -> M1	M -> M1	
D6323.012	67-HO-160-M	67-HO-160-M	5.02HR	M1,M2			SF4: M -> M1	M -> M1	
22499.032.1	70-YB-173-G/T	70-YB-173-G		0					Quasi-metastable state is considered.
22499.032.3	70-YB-173-L/G	70-YB-173-G		0					Quasi-metastable state is considered.
22499.033.1	70-YB-174-G/T	70-YB-174-G		0					Quasi-metastable state is considered.
22499.033.3	70-YB-174-L/G	70-YB-174-G		0					Quasi-metastable state is considered.

22499.034.1	70-YB-175-G/T	70-YB-175-G		0				Quasi-metastable state is considered.
22499.034.3	70-YB-175-L/G	70-YB-175-G		0				Quasi-metastable state is considered.
12088.002.1	71-LU-177-G/M1	71-LU-177-M1	161.0D	M		SF4: G/M1 -> G/M	M1 -> M	
20625.026	71-LU-177-M1	71-LU-177-M1	155.D	M		SF4: M1 -> M	M1 -> M	
20625.027	71-LU-177-M1	71-LU-177-M1	155.D	M		SF4: M1 -> M	M1 -> M	
12088.002.2	71-LU-177-M1	71-LU-177-M1	161.0D	M		SF4: M1 -> M	M1 -> M	
A0598.002	71-LU-177-M1	71-LU-177-M1	160.D	M		SF4: M1 -> M	M1 -> M	
V1002.352.2	71-LU-177-M1	71-LU-177-M1	160.4D	M		SF4: M1 -> M	M1 -> M	
V1002.354.2	71-LU-177-M1	71-LU-177-M1	160.4D	M		SF4: M1 -> M	M1 -> M	
30605.005	71-LU-178-M1	71-LU-178-M1	20.MIN	M		SF4: M1 -> G or M	M1 -> G or M	Half-life does not help to identify G or M.
D6086.010	72-HF-177-M	72-HF-177-M	51.4MIN	M1,M2		SF4: M -> M2	M -> M2	
A0822.009	72-HF-178-M/G	72-HF-178-M		M1,M2				
A0822.013	72-HF-178-M/G	72-HF-178-M		M1,M2				
22926.025	72-HF-178-M/T	72-HF-178-M		M1,M2				
11850.010	72-HF-179-M	72-HF-179-M	18.7SEC	M1,M2		SF4: M -> M1	M -> M1	
30248.011	72-HF-179-M	72-HF-179-M		M1,M2				
G4020.008	72-HF-179-M	72-HF-179-M	18.68SEC	M1,M2		SF4: M -> M1	M -> M1	
V1002.371.2	72-HF-179-M	72-HF-179-M	18.67SEC	M1,M2		SF4: M -> M1	M -> M1	
A0822.010	72-HF-179-M/G	72-HF-179-M		M1,M2				
A0822.014	72-HF-179-M/G	72-HF-179-M		M1,M2				
23260.135	72-HF-181-G	72-HF-181-G	42.39D	0		SF4: Delete -G.		
23260.136	72-HF-181-G	72-HF-181-G	42.39D	0		SF4: Delete -G.		
33004.016	73-TA-178-M	73-TA-178-M	2.36HR	M1,M2	*	SF4: M -> G+M2	M -> G	
A0431.113	73-TA-178-M	73-TA-178-M		M1,M2	*			
A0598.006	73-TA-178-M	73-TA-178-M	2.5HR	M1,M2	*	SF4: M -> G+M2	M -> G	
B0032.002.2	73-TA-178-M	73-TA-178-M	2.1HR	M1,M2	*	SF4: M -> G+M2	M -> G	
D0995.005	73-TA-178-M	73-TA-178-M	2.36HR	M1,M2	*	SF4: M -> G+M2	M -> G	
D4233.013	73-TA-178-M	73-TA-178-M	2.36HR	M1,M2	*	SF4: M -> G+M2	M -> G	

D4254.003	73-TA-178-M	73-TA-178-M	2.36HR	M1,M2	*		SF4: M -> G+M2	M -> G	
D4305.009	73-TA-178-M	73-TA-178-M	2.36HR	M1,M2	*		SF4: M -> G+M2	M -> G	
D6181.012	73-TA-178-M	73-TA-178-M	2.50HR	M1,M2	*		SF4: M -> G+M2	M -> G	
D6303.012	73-TA-178-M	73-TA-178-M	2.36HR	M1,M2	*		SF4: M -> G+M2	M -> G	
D6303.024	73-TA-178-M	73-TA-178-M	2.36HR	M1,M2	*		SF4: M -> G+M2	M -> G	
D7006.014	73-TA-178-M	73-TA-178-M	2.36HR	M1,M2	*		SF4: M -> G+M2	M -> G	
D7006.028	73-TA-178-M	73-TA-178-M		M1,M2	*				
E2466.014	73-TA-178-M	73-TA-178-M	2.36HR	M1,M2	*		SF4: M -> G+M2	M -> G	
G4094.002	73-TA-178-M	73-TA-178-M	2.36HR	M1,M2	*		SF4: M -> G+M2	M -> G	
G4098.002	73-TA-178-M	73-TA-178-M	2.36HR	M1,M2	*		SF4: M -> G+M2	M -> G	
M1031.002.1	73-TA-178-M	73-TA-178-M		M1,M2	*				
M1031.002.2	73-TA-178-M	73-TA-178-M		M1,M2	*				
M1031.004	73-TA-178-M	73-TA-178-M		M1,M2	*				
O0768.184	73-TA-178-M	73-TA-178-M	2.36HR	M1,M2	*		SF4: M -> G+M2	M -> G	
A0635.003	73-TA-178-M/G	73-TA-178-M	2.45HR	M1,M2	*		SF4: M/G -> G+M2/M1	M -> G	
G4094.005	73-TA-178-M/G	73-TA-178-M		M1,M2	*				
G4098.005	73-TA-178-M/G	73-TA-178-M	2.36HR	M1,M2	*		SF4: M/G -> G+M2/M1	M -> G	
M0936.002	73-TA-178-M/G	73-TA-178-M	2.4HR	M1,M2	*		SF4: M/G -> G+M2/M1	M -> G	
C2325.014	73-TA-182-M	73-TA-182-M		M1,M2					
23495.002.1	76-OS-193-M	76-OS-193-M	17.MIN	0		Y			
O0690.059	77-IR-188-G	77-IR-188-G	41.5HR	0			SF4: Delete -G.	Delete -G.	
G4017.002	77-IR-190-M/G	77-IR-190-M	3.25HR	M1,M2			SF4: M/G -> M2/G+M1	M -> M2	
K2027.282	77-IR-190-M/G	77-IR-190-M		M1,M2			SF4: M/G -> M2/G+M1		T1/2(m2)=3.1 hr in K2027.225.
11817.019	77-IR-191-M	77-IR-191-M	4.9SEC	M1,M2			SF4: M -> M1. SF5: Add (M).		Uncertain if M2 has IT branch to M1 state
11850.011	77-IR-191-M	77-IR-191-M	4.9SEC	M1,M2			SF4: M -> M1. SF5: Add (M).	M -> M1	Uncertain if M2 has IT branch to M1 state
14041.002	77-IR-191-M	77-IR-191-M		M1,M2			SF4: M -> M1		Detection of prompt gamma to m1 state
14041.007	77-IR-191-M	77-IR-191-M		M1,M2			SF4: M -> M1		Detection of prompt gamma to m1 state

14255.014	77-IR-191-M	77-IR-191-M	4.94SEC	M1,M2	SF4: M -> M1; SF5: Add (M).	M -> M1	Uncertain if M2 has IT branch to M1 state
30338.003	77-IR-191-M	77-IR-191-M	4.9SEC	M1,M2	SF4: M -> M1; SF5: Add (M).	M -> M1	Uncertain if M2 has IT branch to M1 state
G4020.004	77-IR-191-M	77-IR-191-M	4.94SEC	M1,M2	SF4: M -> M1; SF5: Add (M).	M -> M1	Uncertain if M2 has IT branch to M1 state
14255.017	77-IR-191-M/G	77-IR-191-M	4.94SEC	M1,M2		M -> M1	Uncertain if M2 has IT branch to M1 state
40171.003	77-IR-192-G+M	77-IR-192-M		M1,M2	SF4: G+M -> G+M1		
11748.022	77-IR-192-M	77-IR-192-M	1.45MIN	M1,M2	SF4: M -> M1	M -> M1	
12166.002	77-IR-192-M	77-IR-192-M	600.YR*	M1,M2	SF4: M -> M2?	Move HL=600.MIN from COMMON.	M2 (241 yr)?
F1226.004	77-IR-194-M2/G	77-IR-194-M2	171.D	M	SF4: M2/G -> M/G	M2 -> M	
21627.006	79-AU-196-M	79-AU-196-M	9.7HR	M1,M2	SF4: M -> M2	M -> M2	
22335.016	79-AU-196-M	79-AU-196-M	Uwamino	M1,M2			
C2273.006	79-AU-196-M	79-AU-196-M		M1,M2			
E1306.010	79-AU-196-M	79-AU-196-M	9.7HR	M1,M2	SF4: M -> M2	M -> M2	
E1306.012	79-AU-196-M	79-AU-196-M	9.7HR	M1,M2	SF4: M -> M2	M -> M2	
E1306.014	79-AU-196-M	79-AU-196-M	9.7HR	M1,M2	SF4: M -> M2	M -> M2	
F1320.012	79-AU-196-M	79-AU-196-M	9.6HR	M1,M2	SF4: M -> M2	M -> M2	
O2014.004.1	79-AU-196-M	79-AU-196-M	9.7HR	M1,M2	SF4: M -> M2	M -> M2	
R0050.004.2	79-AU-196-M	79-AU-196-M	9.7HR	M1,M2	SF4: M -> M2	M -> M2	
21627.007	79-AU-196-M/G	79-AU-196-M	9.7HR	M1,M2	SF4: M/G -> M2/G+M1	M -> M2	
21847.003	79-AU-196-M/G	79-AU-196-M	9.7HR	M1,M2	SF4: M/G -> M2/G+M1	M -> M2	
30101.015	79-AU-196-M/G	79-AU-196-M		M1,M2			
41346.002	79-AU-196-M/G	79-AU-196-M		M1,M2			
31490.004.1	79-AU-196-M/G	79-AU-196-M	9.7HR	M1,M2	SF4: M/G -> M2/G+M1	M -> M2	
31490.004.2	79-AU-196-M/G	79-AU-196-M	9.7HR	M1,M2	SF4: M/G -> M2/G+M1	M -> M2	
A0461.002.4	79-AU-196-M/G	79-AU-196-M		M1,M2			
C2548.012	79-AU-196-M/G	79-AU-196-M		M1,M2			
E1306.020	79-AU-196-M/G	79-AU-196-M	9.7HR	M1,M2	SF4: M/G -> M2/G+M1	M -> M2	
E1306.021	79-AU-196-M/G	79-AU-196-M	9.7HR	M1,M2	SF4: M/G -> M2/G+M1	M -> M2	
E1306.022	79-AU-196-M/G	79-AU-196-M	9.7HR	M1,M2	SF4: M/G -> M2/G+M1	M -> M2	

F0835.005	79-AU-196-M/G	79-AU-196-M	9.7HR	M1,M2		SF4: M/G -> M2/G+M1	M -> M2	
F1299.009	79-AU-196-M/G	79-AU-196-M		M1,M2				
F1320.013	79-AU-196-M/G	79-AU-196-M		M1,M2		SF4: M/G -> M2/G+M1		
G3101.002	79-AU-196-M/G	79-AU-196-M	9.6HR	M1,M2		SF4: M/G -> M2/G+M1	M -> M2	
G4017.003	79-AU-196-M/G	79-AU-196-M	9.7HR	M1,M2		SF4: M/G -> M2/G+M1	M -> M2	
G4027.004	79-AU-196-M/G	79-AU-196-M	9.7HR	M1,M2		SF4: M/G -> M2/G+M1	M -> M2	
M0061.002	79-AU-196-M/G	79-AU-196-M		M1,M2				
O0189.004	79-AU-196-M/G	79-AU-196-M	9.7HR	M1,M2		SF4: M/G -> M2/G+M1	M -> M2	
31254.010	79-AU-196-M/T	79-AU-196-M	10.HR	M1,M2		SF4: M/T -> M2/T		
41240.136	79-AU-196-M/T	79-AU-196-M		M1,M2				
D6011.002	79-AU-196-M/T	79-AU-196-M		M1,M2				
D6011.005	79-AU-196-M/T	79-AU-196-M		M1,M2				
10493.018.G	81-TL-202-G	81-TL-202-G	12.5D	0				Quasi-metastable state is considered.
10493.020	81-TL-202-L/G	81-TL-202-G	12.5D	0				Quasi-metastable state is considered.
10361.006	81-TL-204-M	81-TL-204-M	67.MICROSEC	0		SF4: M -> L	M -> L	
21503.008	82-PB-203-M	82-PB-203-M	5.9SEC	M1,M2		SF4: M -> M1+M2		
30069.006	82-PB-203-M	82-PB-203-M		M1,M2				
30156.011	82-PB-203-M	82-PB-203-M	6.1SEC	M1,M2		SF4: M -> M1+M2	M -> M1	
30101.016	82-PB-203-M/G	82-PB-203-M		M1,M2				
10361.005	82-PB-205-M	82-PB-205-M	5.54MSEC	0		SF4: M -> L	M -> L	
31492.012	82-PB-205-M	82-PB-205-M	5.5MSEC	0		SF4: M -> L	M -> L	
31492.008.2	82-PB-205-M	82-PB-205-M	5.5MSEC	0		SF4: M -> L	M -> L	
31492.003	82-PB-206-M	82-PB-206-M	.124MSEC	0		SF4: M -> L	M -> L	
31492.013	82-PB-206-M	82-PB-206-M	.124MSEC	0		SF4: M -> L	M -> L	
31492.002.2	82-PB-206-M	82-PB-206-M	.124MSEC	0		SF4: M -> L	M -> L	
31492.004.2	82-PB-206-M	82-PB-206-M	.124MSEC	0		SF4: M -> L	M -> L	
31492.006.2	82-PB-206-M	82-PB-206-M	.124MSEC	0		SF4: M -> L	M -> L	
31492.007.2	82-PB-206-M	82-PB-206-M	.124MSEC	0		SF4: M -> L	M -> L	
D5082.019	83-BI-200-M	83-BI-200-M	31.MIN	M1,M2	*	SF4: M -> M1	M -> M1	

D6317.003	83-BI-200-M	83-BI-200-M	31.MIN	M1,M2	*	SF4: M -> M1	M -> M1	
10361.002	83-BI-208-M	83-BI-208-M	2.65MSEC	0		SF4: M -> L	M -> L	
A0208.003.B	84-PO-212-M1	84-PO-212-M1	45.1SEC	M		SF4: M1 -> M	M1 -> M	
A0208.003.D	84-PO-212-M1/G	84-PO-212-M1	45.1SEC	M		SF4: M1/G -> M/G	M1 -> M	
A0208.003.C	84-PO-212-M2	84-PO-212-M2	14.NSEC	M		SF4: M2 -> L	M2 -> L	
A0208.003.E	84-PO-212-M2/G	84-PO-212-M2	14.NSEC	M		SF4: M2/G -> L/G	M2 -> L	
S0111.003.3	87-FR-214-M	87-FR-214-M		0				Short-lived alpha quasi-metastable state exists.
E1522.007	89-AC-217-G	89-AC-217-G	111.NSEC	0				Short-lived alpha quasi-metastable state exists.
O1647.004	90-TH-213-G	90-TH-213-G		0				Quasi-metastable state is considered.
O1647.006	90-TH-214-G	90-TH-214-G		0				Quasi-metastable state is considered.
C2563.007	92-U-236-L/G	92-U-236-G		0				Quasi-metastable state is considered.
30459.003.1	92-U-238-L/G	92-U-238-G		0				Quasi-metastable state is considered.
C2563.006	92-U-238-L/G	92-U-238-G		0				Quasi-metastable state is considered.
B0139.003	94-PU-235-G	94-PU-235-G	25.6MIN	0		SF4: Delete -G.	Delete -G.	
B0139.007	94-PU-235-G	94-PU-235-G	25.6MIN	0		SF4: Delete -G.	Delete -G.	
B0139.011	94-PU-235-G	94-PU-235-G	25.6MIN	0		SF4: Delete -G.	Delete -G.	
B0139.002	94-PU-236-G	94-PU-236-G	2.85YR	0		SF4: Delete -G.	Delete -G.	
B0139.006	94-PU-236-G	94-PU-236-G	2.85YR	0		SF4: Delete -G.	Delete -G.	
B0139.010	94-PU-236-G	94-PU-236-G	2.85YR	0		SF4: Delete -G.	Delete -G.	
A0119.003	95-AM-238-G	95-AM-238-G		0				Short-lived SF quasi-metastable state exists.
A0119.002.1	95-AM-239-G	95-AM-239-G		0				Short-lived SF quasi-metastable state exists.
41216.002.2	95-AM-240-G	95-AM-240-G		0				Quasi-metastable state is considered.
A0119.002.2	95-AM-240-G	95-AM-240-G		0				Short-lived SF quasi-metastable state exists.
41216.002.3	95-AM-240-L/G	95-AM-240-G		0				Quasi-metastable state is considered.
M0018.003	95-AM-240-L/G	95-AM-240-G		0				Quasi-metastable state is considered.
V1002.643.2	95-AM-242-M1	95-AM-242-M1	152.YR	M		SF4: M1 -> M	M1 -> M	
V1002.646.2	95-AM-242-M1	95-AM-242-M1	152.YR	M		SF4: M1 -> M	M1 -> M	

40504.003.1	95-AM-244-M1	95-AM-244-M1	1.1E-3SEC	M	SF4: M1 -> L	M1 -> L	
A0071.003	97-BK-242-G	97-BK-242-G	7.MIN	0			Short-lived SF quasi-metastable state exists.
C0578.002	9-F-18-M	9-F-18-M	218.E-9SEC	0	SF4: M -> L	M -> L	