^{61}Mn β^- decay (0.709 s) 2013Ra17,1985Ru05

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Kazimierz Zuber, Balraj Singh	NDS 125, 1 (2015)	25-Jan-2015

Parent: ^{61}Mn: E=0.0; J$^\pi$=(5/2$^-$); $T_{1/2}$=0.709 s *8*; Q(β^-)=7178 *3*; %β^- decay=100.0

^{61}Mn-J$^\pi$,$T_{1/2}$: From Adopted Levels of ^{61}Mn.

^{61}Mn-Q(β^-): From 2012Wa38.

^{61}Mn-%β^- decay: %β^-n≤0.2 to first excited state in ^{60}Fe (2013Ra17) from upper limit of intensity of 824γ (from first 2$^+$ to g.s. in ^{60}Fe). Total %β^-n could not be determined due to long half-life of ^{60}Fe. 2013Ra17 use %β^-n=0.6 *1* from 2000HaZL (thesis).

2013Ra17: ^{61}Mn produced in induced fission of uranium at ISOLDE-CERN facility. E(proton)=1.4 GeV beam impinged a UC_x target of thickness 45 g/cm^2. Reaction products where ionized by RILIS and separated based on their A/Q ratio using a High-Resolution Separator. ^{61}Mn obtained in the reaction was implanted on an aluminized mylar tape for the decay. Measured Eγ, Iγ, $\gamma\gamma$-coin, half-life using three plastic ΔE β detectors and two MiniBall γ-detector clusters. Deduced levels, J, π, β feeding intensities, log *ft*. Comparison with ^{59}Fe data, and with shell-model calculations.

1985Ru05: first identification of ^{61}Mn from fragmentation of ^{82}Se beam at 11.5 MeV/nucleon on tungsten target using on-line mass separator. Measured Eγ, Iγ, $\beta\gamma$-, $\gamma\gamma$-coin, and $T_{1/2}$ by Ge(Li) and plastic scintillator. Three excited states at 207, 391 and 629 keV were proposed through the observation of five γ rays.

1999Ha05: 1-GeV proton -induced spallation of uranium UC_2 target at ISOLDE-CERN facility. The laser ionized Mn isotopes were extracted from the ion source and mass separated. Using tape systems measured β-delayed neutron multiscaling, Eγ and $\gamma\gamma$ coincidence. β-delayed neutron data were collected by multiscaling measurements using Mainz 4π He neutron counter.

All data are from 2013Ra17.

From RADLIST code, deduced total decay energy is 5962 keV *841* as compared to Q(β^-)=7178 keV *3*, which suggests that the decay scheme is not known well.

^{61}Fe Levels

E(level)†	J$^\pi$‡	$T_{1/2}$	Comments
0.0	(3/2$^-$)	5.98 min *6*	$T_{1/2}$: from Adopted Levels of ^{61}Fe.
206.90 *5*	(5/2$^-$)		
391.29 *6*	(1/2$^-$)		
629.08 *7*	(3/2$^-$)		
861.60 *11*	(9/2$^+$)	239 ns *5*	$T_{1/2}$: from 2004Ma80.
959.47 *10*	(7/2$^-$)		
1013.07 *8*	(1/2$^-$)		
1160.97 *7*	(5/2$^-$)		
1252.86 *7*	(3/2$^-$)		
1262.46 *8*	(3/2,5/2,7/2$^-$)		
1477.31 *11*	(9/2$^-$)		
1705.2 *5*	(1/2$^-$,9/2$^-$)		
1893.12 *11*	(3/2,5/2$^-$)		J$^\pi$: 2013Ra17 suggest (1/2$^-$,3/2$^-$,5/2$^-$).
1929.00 *10*	(3/2,5/2$^-$)		J$^\pi$: 2013Ra17 suggest (1/2$^-$,3/2$^-$,5/2$^-$).
2143.72 *7*	(3/2$^-$,5/2$^-$)		
2510.58 *8*	(3/2$^-$,5/2$^-$)		
2717.03 *15*	(5/2$^-$,7/2)		
2964.4 *5*	(3/2,5/2,7/2)		
3049.2 *3*	(5/2$^-$,7/2)		
3079.98 *22*	(3/2,5/2,7/2$^-$)		
3513.5 *4*	(3/2,5/2$^-$)		

† From least-squares fit to Eγ values. Reduced χ^2=2.1 is somewhat larger than critical χ^2=1.7.

‡ From Adopted Levels. Most of the assignments are based on shell-model calculations using GXPF1A interaction corroborated by β feedings and associated log *ft* values, and also comparison with the decay scheme of ^{59}Mn to ^{59}Fe.

^{61}Mn β^- decay (0.709 s) 2013Ra17,1985Ru05 (continued)

β^- radiations

E(decay)	E(level)	Iβ^-†	Log *ft*	Comments
(3665 *3*)	3513.5	0.12 *3*	6.1 *1*	av Eβ=1608.6 *15*
(4098 *3*)	3079.98	0.22 *5*	6.1 *1*	av Eβ=1818.4 *15*
(4129 *3*)	3049.2	0.21 *5*	6.1 *1*	av Eβ=1833.3 *15*
(4214 *3*)	2964.4	0.13 *2*	6.37 *7*	av Eβ=1874.4 *15*
(4461 *3*)	2717.03	0.19 *3*	6.32 *7*	av Eβ=1994.5 *15*
(4667 *3*)	2510.58	1.8 *1*	5.43 *3*	av Eβ=2094.9 *15*
(5034 *3*)	2143.72	2.7 *1*	5.40 *2*	av Eβ=2273.4 *15*
(5249 *3*)	1929.00	0.55 *5*	6.17 *4*	av Eβ=2378.0 *15*
(5285 *3*)	1893.12	0.78 *7*	6.04 *4*	av Eβ=2395.5 *15*
(5473‡ *3*)	1705.2	<0.11	>7.0	av Eβ=2487.2 *15* Iβ^-: 0.09 *2* from intensity balance, but none is expected from ΔJ^π.
(5701‡ *3*)	1477.31	<0.09	>7.1	av Eβ=2598.3 *15* Iβ^-: 0.02 *7* from intensity balance, but none is expected from ΔJ^π.
(5916 *3*)	1262.46	0.57 *6*	6.40 *5*	av Eβ=2703.2 *15*
(5925 *3*)	1252.86	3.25 *9*	5.64 *1*	av Eβ=2707.9 *15*
(6017 *3*)	1160.97	3.23 *9*	5.68 *1*	av Eβ=2752.7 *15*
(6165‡ *3*)	1013.07	<0.30	>6.8	av Eβ=2825.0 *15* Iβ^-: 0.25 *5* from intensity balance, but none is expected from ΔJ^π.
(6219 *3*)	959.47	0.49 *7*	6.6 *1*	av Eβ=2851.1 *15*
(6316 *3*)	861.60	0.20 *2*	8.98^{1u} *5*	av Eβ=2903.0 *15* Iβ^-: 2013Ra17 list <0.22.
(6549 *3*)	629.08	39.0 *6*	4.76 *1*	av Eβ=3012.5 *15* Additional information 1.
(6787‡ *3*)	391.29	<0.28	>7.0	av Eβ=3128.7 *15* Additional information 2. Iβ^-: 0.21 *7* from intensity balance, but none is expected from ΔJ^π.
(6971 *3*)	206.90	12.6 *8*	5.38 *3*	av Eβ=3218.8 *15* Additional information 3.
(7178 *3*)	0.0	<33	>5.0	av Eβ=3319.9 *15* Iβ^-: 33 *1* in 2013Ra17, see text on page 5 of 2013Ra17 for method of estimating g.s. feeding. Authors state that this feeding should be considered as upper limit due to possible missed γ transitions to the ground state of ^{61}Fe. Other: 74% *4* (1985Ru05) is in sharp disagreement with <33 *1* from 2013Ra17. It should be noted that γ spectrum observed in 1985Ru05 was much incomplete as compared to that in 2013Ra17.

† Absolute intensity per 100 decays.
‡ Existence of this branch is questionable.

γ(^{61}Fe)

Iγ normalization: Deduced by 2013Ra17, based on Iβ=33% *1* to g.s. of ^{61}Fe deduced from known normalization of decay scheme of ^{61}Fe to ^{61}Co.

E$_\gamma$	I$_\gamma$‡	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	Mult.	α#	Comments
201.6 *5*	0.24† *4*	1160.97	(5/2$^-$)	959.47	(7/2$^-$)			
206.8 *1*	54 *2*	206.90	(5/2$^-$)	0.0	(3/2$^-$)	(M1+E2)	0.018 *13*	Additional information 4.
237.8 *1*	4.61 *6*	629.08	(3/2$^-$)	391.29	(1/2$^-$)			Additional information 6.
391.2 *1*	7.37 *9*	391.29	(1/2$^-$)	0.0	(3/2$^-$)			Additional information 5.
422.2 *1*	4.55 *8*	629.08	(3/2$^-$)	206.90	(5/2$^-$)			Additional information 7.

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^{61}Mn β^- decay (0.709 s) 2013Ra17,1985Ru05 (continued)

$\gamma(^{61}Fe)$ (continued)

E_γ	I_γ[‡]	E_i(level)	J_i^π	E_f	J_f^π	Comments
517.9 *5*	0.12[†] *4*	1477.31	(9/2⁻)	959.47	(7/2⁻)	
531.5 *3*	0.15 *4*	1160.97	(5/2⁻)	629.08	(3/2⁻)	
624.0 *5*	0.77[†] *8*	1252.86	(3/2⁻)	629.08	(3/2⁻)	
629.0 *1*	100	629.08	(3/2⁻)	0.0	(3/2⁻)	Additional information 8.
640.5 *3*	0.18 *5*	1893.12	(3/2,5/2⁻)	1252.86	(3/2⁻)	
654.7 *1*	0.56 *6*	861.60	(9/2⁺)	206.90	(5/2⁻)	
752.6 *1*	1.89 *6*	959.47	(7/2⁻)	206.90	(5/2⁻)	
806.6 *3*	0.21 *5*	1013.07	(1/2⁻)	206.90	(5/2⁻)	
861.5 *1*	0.49 *5*	1252.86	(3/2⁻)	391.29	(1/2⁻)	
954.1 *1*	2.88 *9*	1160.97	(5/2⁻)	206.90	(5/2⁻)	
959.4 *2*	0.43 *12*	959.47	(7/2⁻)	0.0	(3/2⁻)	
982.4 *5*	0.22[†] *8*	2143.72	(3/2⁻,5/2⁻)	1160.97	(5/2⁻)	
1013.0 *1*	1.30 *7*	1013.07	(1/2⁻)	0.0	(3/2⁻)	
1046.0 *1*	4.49 *9*	1252.86	(3/2⁻)	206.90	(5/2⁻)	
1055.3 *1*	1.05 *7*	1262.46	(3/2,5/2,7/2⁻)	206.90	(5/2⁻)	
1130.6 *1*	0.65 *7*	2143.72	(3/2⁻,5/2⁻)	1013.07	(1/2⁻)	
1161.0 *1*	6.15 *11*	1160.97	(5/2⁻)	0.0	(3/2⁻)	
1184.6 *5*	0.23[†] *7*	2143.72	(3/2⁻,5/2⁻)	959.47	(7/2⁻)	
1239.7 *1*	0.53 *8*	2717.03	(5/2⁻,7/2)	1477.31	(9/2⁻)	
1252.9 *1*	3.66 *10*	1252.86	(3/2⁻)	0.0	(3/2⁻)	
1258.5 *5*	0.26[†] *12*	2510.58	(3/2⁻,5/2⁻)	1252.86	(3/2⁻)	
1262.7 *1*	0.54 *15*	1262.46	(3/2,5/2,7/2⁻)	0.0	(3/2⁻)	
1263.7 *5*	0.63[†] *10*	1893.12	(3/2,5/2⁻)	629.08	(3/2⁻)	
1270.4 *1*	0.71 *15*	1477.31	(9/2⁻)	206.90	(5/2⁻)	
1350.8 *5*	0.31[†] *10*	2510.58	(3/2⁻,5/2⁻)	1160.97	(5/2⁻)	
1498.3[@] *5*	0.25[@†] *4*	1705.2	(1/2⁻,9/2⁻)	206.90	(5/2⁻)	
1498.3[@] *5*	0.18[@†] *7*	2510.58	(3/2⁻,5/2⁻)	1013.07	(1/2⁻)	
1501.7 *1*	0.76[†] *9*	1893.12	(3/2,5/2⁻)	391.29	(1/2⁻)	
1537.7 *1*	0.36 *6*	1929.00	(3/2,5/2⁻)	391.29	(1/2⁻)	
1571.9 *3*	0.24 *7*	3049.2	(5/2⁻,7/2)	1477.31	(9/2⁻)	
[x]1690.2 *5*	0.19 *6*					
1722.1 *2*	0.29 *6*	1929.00	(3/2,5/2⁻)	206.90	(5/2⁻)	
[x]1738.5 *5*	0.15 *6*					
[x]1846.7 *5*	0.16 *5*					
1893.9 *3*	0.57 *14*	1893.12	(3/2,5/2⁻)	0.0	(3/2⁻)	
1928.9 *2*	0.86 *12*	1929.00	(3/2,5/2⁻)	0.0	(3/2⁻)	
1936.8 *1*	0.90 *11*	2143.72	(3/2⁻,5/2⁻)	206.90	(5/2⁻)	
2089.6 *5*	0.35[†] *10*	3049.2	(5/2⁻,7/2)	959.47	(7/2⁻)	
2120.3 *5*	0.25[†] *6*	2510.58	(3/2⁻,5/2⁻)	391.29	(1/2⁻)	
2143.7 *1*	5.54 *14*	2143.72	(3/2⁻,5/2⁻)	0.0	(3/2⁻)	
2303.5 *1*	1.18 *9*	2510.58	(3/2⁻,5/2⁻)	206.90	(5/2⁻)	
2510.5 *1*	2.86 *12*	2510.58	(3/2⁻,5/2⁻)	0.0	(3/2⁻)	
2757.4 *5*	0.37[†] *7*	2964.4	(3/2,5/2,7/2)	206.90	(5/2⁻)	
2873.7 *3*	0.26 *9*	3079.98	(3/2,5/2,7/2⁻)	206.90	(5/2⁻)	
3079.2 *3*	0.34 *10*	3079.98	(3/2,5/2,7/2⁻)	0.0	(3/2⁻)	
3122.1 *4*	0.32 *9*	3513.5	(3/2,5/2⁻)	391.29	(1/2⁻)	
[x]3146.1 *10*	0.26 *10*					

[†] From $\gamma\gamma$-coin data; transition not seen in singles spectrum.
[‡] For absolute intensity per 100 decays, multiply by 0.363 *7*.

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^{61}Mn β^- decay (0.709 s) 2013Ra17,1985Ru05 (continued)

$\gamma(^{61}Fe)$ (continued)

Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

@ Multiply placed with intensity suitably divided.

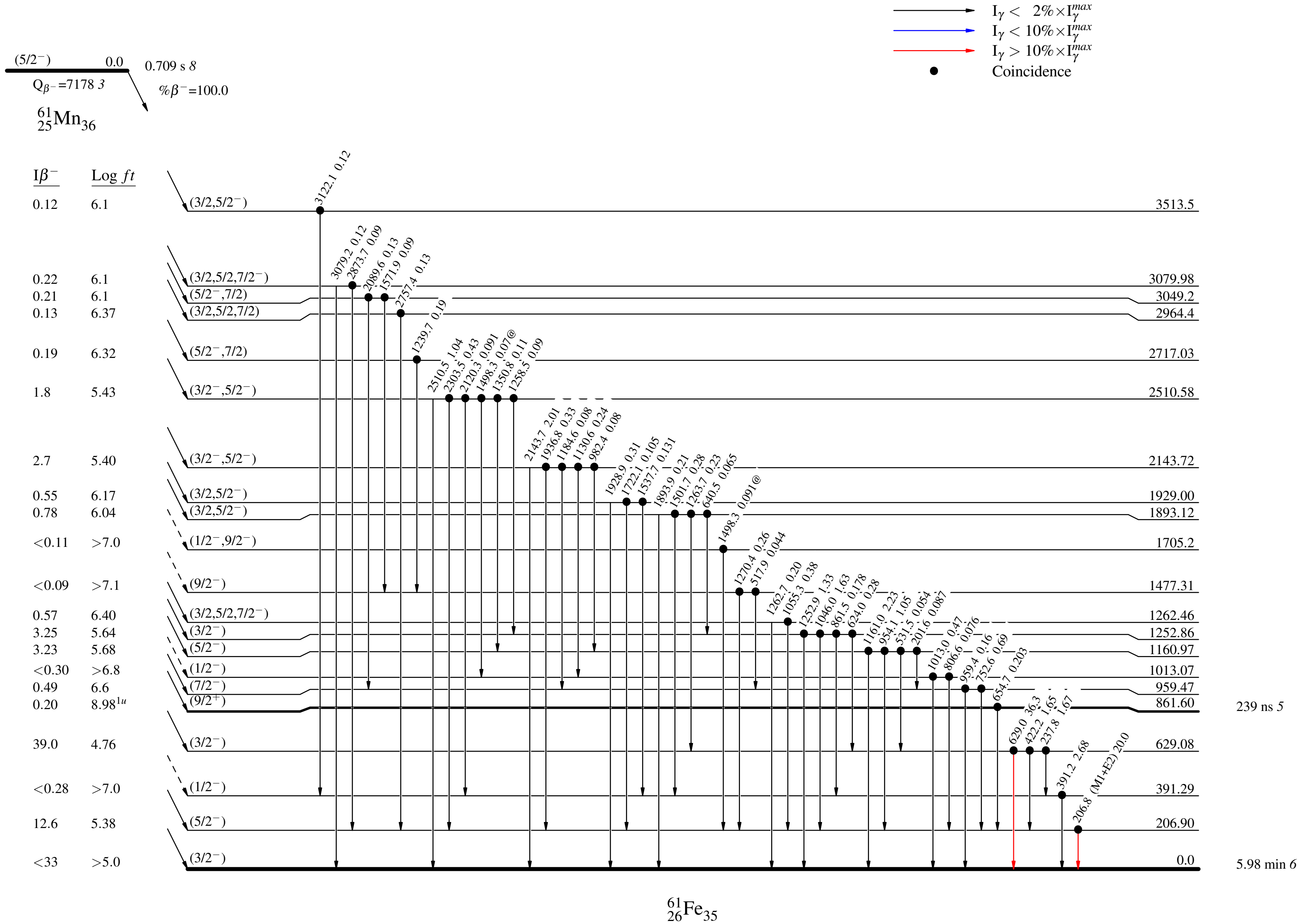
x γ ray not placed in level scheme.

^{61}Mn β^- decay (0.709 s) 2013Ra17,1985Ru05

Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays
@ Multiply placed: intensity suitably divided

Legend



From ENSDF