^{60}Mn β^- decay (1.77 s) 2010Ho13,1978No03

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	E. Browne, J. K. Tuli	NDS 114, 1849 (2013)	31-Dec-2012

Parent: ^{60}Mn: E=271.21 *24*; $J^\pi=4^+$; $T_{1/2}$=1.77 s *2*; Q(β^-)=8444 *4*; %β^- decay=88.5 *8*

^{60}Mn-Q(β^-): From 2012Wa38.

^{60}Mn-E,J^π,$T_{1/2}$: From Adopted Levels for ^{60}Mn.

^{60}Mn-%β^- decay: %β^-=88.5 *8* in ^{60}Mn Adopted Levels.

2010Ho13: ^{60}Mn formed in ^{238}U(^{64}Ni,X) reaction at E=430 MeV beam provided by ATLAS facility at Argonne. Target= 55 mg/cm^2. Measured Eγ, Iγ, $\gamma\gamma$, $\gamma\gamma(\theta)$ using GAMMASPHERE array of 100 Compton-suppressed HPGe detectors.

Additional information 1.

Others:

1988Bo06: ^{60}Mn from W(^{76}Ge,X), E=11.5 MeV/nucleon, mass separation, measured Eγ, Iγ, $\beta\gamma$ coin, $T_{1/2}$.

1985Ru05: ^{60}Mn from W(^{82}Se,X), E=11.5 MeV/nucleon, mass separation, measured Eγ, Iγ, $\beta\gamma$ coin, $T_{1/2}$.

1978No03: ^{60}Mn from ^{48}Ca(^{18}O,αpn), E=56 MeV. Measured t, Eγ, Iγ, Eβ, $\gamma\gamma$ coin, $\beta\gamma$ coin, Enriched target (96.8%). Ge(Li) detectors, plastic scintillators. Discovery of ^{60}Mn.

^{60}Fe Levels

E(level)[†]	J^π	$T_{1/2}$	Comments
0.0	0^+	2.62×10^6 y *4*	$T_{1/2}$: From Adopted Levels, Gammas.
823.83 *9*	2^+		
2114.60 *12*	4^+		
2299.67 *11*			$J^\pi=2^+$ from 1476γ M1 to 2^+, and 2300γ E2 to 0^+. However, log *ft*=6.0 to 2300-keV level is not consistent with β^- decay from ^{60}Mn(4^+) to ^{60}Fe(2^+).
2792.68 *11*	3^+,4^+		
3072.01 *23*	4^+		
3193.51 *24*			
3352.9 *6*			
3486.02 *24*			
3498.6 *10*	4^+		

[†] Deduced by evaluators from least-squares fit to γ-ray energies.

β^- radiations

E(decay)	E(level)	Iβ^-[†#]	Log *ft*[‡]	Comments
(5217 *4*)	3498.6	0.4 *4*	>6.1	av Eβ=2360.8 *21*
(5229 *4*)	3486.02	2.7 *3*	5.9	av Eβ=2367.0 *20*
(5362 *4*)	3352.9	0.53 *23*	6.6	av Eβ=2431.9 *20*
(5522 *4*)	3193.51	2.2 *3*	6.1	av Eβ=2509.6 *20*
(5643 *4*)	3072.01	3.2 *5*	5.9	av Eβ=2568.9 *20*
(5923 *4*)	2792.68	73 *3*	4.7	av Eβ=2705.2 *20*
(6416 *4*)	2299.67	5.0 *15*	6.0	av Eβ=2946.0 *20*
(6601 *4*)	2114.60	2.4 *11*	6.4	av Eβ=3036.4 *20*

[†] Deduced by evaluators from γ-ray transition intensity balance at each level. These should be considered limits since the decay scheme may not be complete.

[‡] Values deduced by evaluators.

[#] For absolute intensity per 100 decays, multiply by 0.885 *8*.

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$\gamma(^{60}Fe)$

Iγ normalization: Deduced by evaluators from Iγ(823.8)+Iγ(2299.7γ)=88.5% 8.

E_γ[†]	I_γ[†#]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	α[@]	Comments
279.6 *7*	0.3 *2*	3072.01	4^+	2792.68	3^+,4^+	M1	0.00260 *4*	α=0.00260 *4*; α(K)=0.00234 *4*; α(L)=0.000226 *4*; α(M)=3.11×10^{-5} *5*; α(N+..)=1.431×10^{-6} *22* α(N)=1.431×10^{-6} *22*
401.0[&] *10*	0.2 *2*	3193.51		2792.68	3^+,4^+			
493.0 *1*	24.9 *13*	2792.68	3^+,4^+	2299.67		(M1)	0.000697 *10*	α=0.000697 *10*; α(K)=0.000628 *9*; α(L)=6.02×10^{-5} *9*; α(M)=8.29×10^{-6} *12*; α(N+..)=3.84×10^{-7} *6* α(N)=3.84×10^{-7} *6* I$_\gamma$: Weighted average of 26.2 *20* (2010Ho13) and 24.4 *13* (1978No03).
678.1 *1*	3.5 *4*	2792.68	3^+,4^+	2114.60	4^+	(M1)	0.000348 *5*	α=0.000348 *5*; α(K)=0.000314 *5*; α(L)=3.00×10^{-5} *5*; α(M)=4.13×10^{-6} *6*; α(N+..)=1.92×10^{-7} *3* α(N)=1.92×10^{-7} *3* I$_\gamma$: Weighted average of 3.6 *4* (2010Ho13) and 3.0 *7* (1978No03).
823.8 *1*	100	823.83	2^+	0.0	0^+	E2	0.000319 *5*	α=0.000319 *5*; α(K)=0.000287 *4*; α(L)=2.75×10^{-5} *4*; α(M)=3.78×10^{-6} *6*; α(N+..)=1.740×10^{-7} *25* α(N)=1.740×10^{-7} *25*
957.5 *3*	1.3 *2*	3072.01	4^+	2114.60	4^+	M1	0.0001708 *24*	α=0.0001708 *24*; α(K)=0.0001540 *22*; α(L)=1.464×10^{-5} *21*; α(M)=2.02×10^{-6} *3* α(N)=9.39×10^{-8} *14*
1078.9 *2*	2.9 *4*	3193.51		2114.60	4^+			
[x]1150.2 *4*	1.6 *4*							E$_\gamma$,I$_\gamma$: From 1985Ru05.
1238.3 *5*	0.7 *3*	3352.9		2114.60	4^+			
1290.8 *1*	15.7 *11*	2114.60	4^+	823.83	2^+	E2	0.0001356 *19*	α=0.0001356 *19*; α(K)=9.84×10^{-5} *14*; α(L)=9.36×10^{-6} *14*; α(M)=1.289×10^{-6} *18*; α(N+..)=2.65×10^{-5} α(N)=5.98×10^{-8} *9*; α(IPF)=2.65×10^{-5} *4* I$_\gamma$: Weighted average of 16.4 *8* (2010Ho13) and 13.9 *13* (1978No03). (1291γ)(824γ)(θ): A$_2$=+0.17 *7*, A$_4$=+0.05 *9*.
1371.4 *2*	3.6 *4*	3486.02		2114.60	4^+			
1384.0 *10*	0.5 *5*	3498.6	4^+	2114.60	4^+	M1	0.0001201 *17*	α=0.0001201 *17*; α(K)=7.55×10^{-5} *11*; α(L)=7.15×10^{-6} *10*; α(M)=9.86×10^{-7} *14*; α(N+..)=3.65×10^{-5} *6* α(N)=4.60×10^{-8} *7*; α(IPF)=3.64×10^{-5} *6*
1475.8 *1*	14.0 *7*	2299.67		823.83	2^+	M1	0.0001331 *19*	α=0.0001331 *19*; α(K)=6.70×10^{-5} *10*; α(L)=6.35×10^{-6} *9*; α(M)=8.74×10^{-7} *13*; α(N+..)=5.89×10^{-5} *9* α(N)=4.08×10^{-8} *6*; α(IPF)=5.88×10^{-5} *9*

Continued on next page (footnotes at end of table)

^{60}Mn β^- decay (1.77 s) 2010Ho13,1978No03 (continued)

$\gamma(^{60}Fe)$ (continued)

E_γ †	I_γ †#	E_i(level)	J_i^π	E_f	J_f^π	Mult.‡	α@	Comments
								α(N)=4.08×10^{-8} *6*; α(IPF)=5.88×10^{-5} *9* I_γ: Weighted average of 13.8 *7* (2010Ho13) and 14.6 *14* (1978No03).
1968.8 *1*	69.0 *34*	2792.68	3$^+$,4$^+$	823.83	2$^+$	(M1)	0.000285 *4*	(1476γ)(824γ)(θ): A_2=−0.18 *7*, A_4=+0.4 *1*. α=0.000285 *4*; α(K)=4.00×10^{-5} *6*; α(L)=3.78×10^{-6} *6*; α(M)=5.21×10^{-7} *8*; α(N+..)=0.000241 *4* α(N)=2.43×10^{-8} *4*; α(IPF)=0.000241 *4* I_γ: Weighted average of 67.2 *34* (2010Ho13) and 71.1 *36* (1978No03).
2248.0 *3*	2.7 *6*	3072.01	4$^+$	823.83	2$^+$	E2	0.000471 *7*	(1969γ)(824γ)(θ): A_2=−0.22 *4*, A_4=−0.02 *5*. α=0.000471 *7*; α(K)=3.35×10^{-5} *5*; α(L)=3.17×10^{-6} *5*; α(M)=4.36×10^{-7} *7*; α(N+..)=0.000434 *6* α(N)=2.03×10^{-8} *3*; α(IPF)=0.000434 *6* I_γ: Weighted average of 2.4 *4* (2010Ho13) and 4.0 *8* (1985Ru05).
2299.7 *2*	17.5 *12*	2299.67		0.0	0$^+$			I_γ: Weighted average of 17.4 *12* (2010Ho13) and 17.6 *20* (1978No03). Mult.: E2 from ΔJ^π not consistent with β^- decay.

† From 2010Ho13, unless otherwise specified.
‡ M1 transitions are expected to be M1+E2.
# For absolute intensity per 100 decays, multiply by 0.753 *11*.
@ 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.
& Placement of transition in the level scheme is uncertain.
x γ ray not placed in level scheme.

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Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays