^{63}Mn β^- decay 2009Ma22

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Jun Chen	NDS 196,17 (2024)	30-Sep-2023

Parent: ^{63}Mn: E=0.0; $J^\pi=5/2^{(-)}$; $T_{1/2}=0.276$ s *6*; $Q(\beta^-)=8749$ *6*; $\%\beta^-$ decay=100

^{63}Mn-J^π,$T_{1/2}$: From Adopted Levels of ^{63}Mn. Adopted $T_{1/2}$ is weighted average of 0.275 s *4* (1999Ha05), 0.322 s *23* (1999Le67,1999So20), 0.24 s *3* (1997AmZZ), 0.29 s *2* (1995AmZX), and 0.25 s *4* (1985Bo49).

2009Ma22: ^{nat}U(p,X) ^{63}Mn source was produced by bombardment of a natural uranium target with 1.4 GeV proton beam from the ISOLDE facility at CERN. Fragments were separated with the High Resolution Seperator (HRS) and selected ions were transported to the decay station. β particles were detected with a thin fast-response plastic scintillator (start) and γ rays were detected with two fast-response γ scintillators (stop) and two Ge detectors. Measured Eγ, Iγ, Eβ, $\gamma\gamma$-coin, $\beta\gamma$(t), $\beta\gamma\gamma$(t). Deduced levels, $T_{1/2}$.

2005GaZR: ^{58}Ni(^{76}Ge,X) ^{63}Mn source was produced by fragmentation of 61.8 MeV/nucleon ^{76}Ge beam on a 150–μm-thick ^{58}Ni target at GANIL. Fragments were separated by the LISE3 mass spectrometer and identified using a telescope of three Si detectors. γ rays were detected with 4 Clover Ge detectors. Measured Eγ, Iγ, $\gamma\gamma$-coin. Deduced levels, J, π, β-decay branching ratios, log *ft*. Comparisons with QPRA calculations.

2002MaZN: Ta(^{86}Kr,X) ^{63}Mn source was produced by fragmentation of 57.8 MeV/nucleon ^{86}Kr beam on a 49.8 mg/cm^2 tantalum target at GANIL. Fragments were separated by the LISE2000 separator and implanted in a telescope of SI(Li) detectors. γ rays were detected with four EXOGAM Ge detectors. Measured Eγ, Iγ, γ(t). Deduced parent $T_{1/2}$.

1985Bo49: W(^{76}Se,X) ^{63}Mn source was produced by fragmentation of 11.4 MeV/nucleon ^{76}Ge beam on a 36 mg/cm^2 natural W target at GSI. Fragments were separated by the GSI on-line mass separator and transported to the counting positions. β particles were detected with a 4π β detector and a β-ray telescope consisting of a Si ΔE and a lucite E detectors; γ rays were detected with two γ-ray detectors. Measured Eγ, Eβ, $\beta\gamma$-coin, β(t). Deduced parent $T_{1/2}$.

Others:

1999So20,1999Le67: ^{58}Ni(^{86}Kr,X) ^{63}Mn source was produced by fragmentation of E=60.4 MeV/nucleon ^{86}Kr beam on a ^{58}Ni target at GANIL. The detector setup is similar to that in 2005GaZR. Measured γ(t). Deduced parent $T_{1/2}$.

1999Ha05: U(p,X) E=1 GeV proton beam from the ISOLDE facility at CERN. Measured β-delayed n(t) using a 4π ^{3}He neutron counter. Deduced parent $T_{1/2}$.

1997AmZZ,1995AmZX: Be(^{86}Kr,X) E=500 MeV/nucleon at GSI. Fragments were separated with the FRS separator. Measured implant-β(t). Deduced parent $T_{1/2}$.

The decay scheme is that from 2009Ma22 and is incomplete due to a large gap between Q=8749 *6* and the reported highest level at E=1543.

^{63}Fe Levels

E(level)†	J^π‡	$T_{1/2}$#	Comments
0.0	$5/2^-$	6.1 s *6*	$T_{1/2}$: From Adopted Levels.
357.5	$(3/2)^-$	110 ps	
451.2	$(3/2^-,5/2^-)$	780 ps	
625.7	$(1/2^-,5/2^-)$		J^π: $(1/2,5/2^-,9/2^+)$ from theoretical predictions in 2005GaZR; 625.7γ to $(5/2^-)$.
681.3	(3/2,5/2,7/2)		
875.8			
906.7	(3/2,5/2,7/2)		
1132.8	$(3/2,5/2,7/2)^-$		
1178.3			
1534.5	$(3/2^-,5/2^-,7/2^-)$		
1542.6			

† From a least-squares fit to γ-ray energies, assuming $\Delta E\gamma=0.5$ keV.

‡ From Adopted Levels.

From $\beta\gamma$(t) in 2009Ma22 for excited states, adopted in Adopted Levels.

^{63}Mn β^- decay 2009Ma22 (continued)

β^- radiations

E(decay)	E(level)	Iβ^-[†#]	Log *ft*	Comments
(7206[@] *6*)	1542.6	1.0	6.1	av Eβ=3336.2 *29*
(7215 *6*)	1534.5	5.4	5.4	av Eβ=3340.3 *29*
(7571[@] *6*)	1178.3	0.8	6.3	av Eβ=3514.6 *29*
(7616 *6*)	1132.8	32[‡]	4.7	av Eβ=3536.8 *29*
(7842 *6*)	906.7	1.3	6.2	av Eβ=3647.0 *29*
(8068 *6*)	681.3	2.8	5.9	av Eβ=3757.1 *29*
(8123[@] *6*)	625.7	1.0	6.4	av Eβ=3784.0 *29*
(8298 *6*)	451.2	9	5.5	av Eβ=3869.5 *29*
(8392 *6*)	357.5	31[‡]	5.0	av Eβ=3916.0 *30* Iβ^-: from 2005GaZR. The authors only state it is deduced from measured intensity of 357γ, but it is likely from γ-ray intensity balance at 357 level and the total β intensity.
(8749 *6*)	0.0	<16	>5.3	av Eβ=4089.9 *29* Iβ^-: from 100−%I(γ to g.s.), considered as an upper limit due to possible missing transitions to g.s. from unobserved high-lying levels.

† From Iγ intensity balance at each level, unless otherwise noted. Quoted values should be considered as approximate due to incomplete decay scheme.

‡ Deduced by 2005GaZR. The authors only state that %Iβ(357)=31 is from Iγ(357γ) and %Iβ(1132)=32 is from Iγ(1132γ), but they could have been deduced by the authors from Iγ intensity balance at the two levels and the total β intensity. Note that the net Iγ feedings at 357 and 1132 levels using Iγ from 2005GaZR are 80 and 66, respectively, and its ratio 80/66 is inconsistent with %Iβ(357)/%Iβ(1132)=31/32. It is very likely that additional feeding to 357 level could have been used by the authors in deducing %Iβ but is missing in their decay scheme, e.g., the 93.8γ from 451 level to 357 level in the decay scheme of 2009Ma22, which doesn't report any %Iβ. Based on Iγ data in 2009Ma22, the ratio of the two net Iγ feedings is 63/65 and is in a good agreement with %Iβ(357)/%Iβ(1132)=31/32 in 2005GaZR, indicating %Iβ(357) and %Iβ(1132) from 2005GaZR are good for use.

Absolute intensity per 100 decays.

@ Existence of this branch is questionable.

γ(^{63}Fe)

Iγ normalization: From %Iβ(357)=31 and %Iβ(1132)=32 in 2005GaZR, which is likely deduced from measured Iγ intensity balance at the two levels and total Iβ intensity, independent from the rest of the decay scheme. But it should be considered as approximate due to incomplete decay scheme.

Eγ[†]	Iγ[†‡]	E$_i$(level)	J$_i^\pi$	E$_f$	J$_f^\pi$	Comments
93.8	13	451.2	(3/2$^-$,5/2$^-$)	357.5	(3/2)$^-$	%Iγ=6.4
229.9	0.45	681.3	(3/2,5/2,7/2)	451.2	(3/2$^-$,5/2$^-$)	%Iγ=0.22
268.1	1.6	625.7	(1/2$^-$,5/2$^-$)	357.5	(3/2)$^-$	%Iγ=0.78
323.7	1.65	681.3	(3/2,5/2,7/2)	357.5	(3/2)$^-$	%Iγ=0.81
357.2	100	357.5	(3/2)$^-$	0.0	5/2$^-$	%Iγ=49 Eγ: others: 357 *2* (2005GaZR), 357 *1* (2002MaZN). Iγ: also from 2005GaZR.
424.4	3.2	875.8		451.2	(3/2$^-$,5/2$^-$)	%Iγ=1.6
451.1	15	451.2	(3/2$^-$,5/2$^-$)	0.0	5/2$^-$	%Iγ=7.4 Eγ,Iγ: other: 451 with Iγ=21, tentative placement in 2005GaZR.
455.5	1.9	906.7	(3/2,5/2,7/2)	451.2	(3/2$^-$,5/2$^-$)	%Iγ=0.93
507.0	14	1132.8	(3/2,5/2,7/2)$^-$	625.7	(1/2$^-$,5/2$^-$)	%Iγ=6.9 Eγ,Iγ: other: 506 *2* with Iγ=14 (2005GaZR).
549.2	0.75	906.7	(3/2,5/2,7/2)	357.5	(3/2)$^-$	%Iγ=0.37

Continued on next page (footnotes at end of table)

^{63}Mn β^- decay 2009Ma22 (continued)

$\gamma(^{63}Fe)$ (continued)

E_γ [†]	I_γ [†‡]	E_i(level)	J_i^π	E_f	J_f^π	Comments
625.7	16	625.7	$(1/2^-,5/2^-)$	0.0	$5/2^-$	%Iγ=7.8 E_γ,I_γ: other: 626 *2* with Iγ=13 (2005GaZR).
658.6	3.6	1534.5	$(3/2^-,5/2^-,7/2^-)$	875.8		%Iγ=1.8
681.7	3.65	681.3	(3/2,5/2,7/2)	0.0	$5/2^-$	%Iγ=1.8
681.7	3.6	1132.8	$(3/2,5/2,7/2)^-$	451.2	$(3/2^-,5/2^-)$	%Iγ=1.8
775.5	13	1132.8	$(3/2,5/2,7/2)^-$	357.5	$(3/2)^-$	%Iγ=6.4 E_γ,I_γ: other: 775 *2* with Iγ=20 (2005GaZR).
820.8	1.6	1178.3		357.5	$(3/2)^-$	%Iγ=0.78
908.8	1.5	1534.5	$(3/2^-,5/2^-,7/2^-)$	625.7	$(1/2^-,5/2^-)$	%Iγ=0.74
1083.4	0.57	1534.5	$(3/2^-,5/2^-,7/2^-)$	451.2	$(3/2^-,5/2^-)$	%Iγ=0.28
1132.8	34	1132.8	$(3/2,5/2,7/2)^-$	0.0	$5/2^-$	%Iγ=17 E_γ,I_γ: other: 1132 *2* with Iγ=32 (2005GaZR).
1177.0	5.4	1534.5	$(3/2^-,5/2^-,7/2^-)$	357.5	$(3/2)^-$	%Iγ=2.7
[x]1464[#] *1*						E_γ: listed in Table 4.2.3 in 2002MaZN. The γ is not seen in other studies and is considered questionable by the evaluator.
1542.6	2.0	1542.6		0.0	$5/2^-$	%Iγ=0.98

[†] From 2009Ma22, unless otherwise noted. ΔEγ is not given by the authors and the evaluator has assumed ΔEγ=0.5 keV in the fitting procedure to obtain E(level) values.

[‡] For absolute intensity per 100 decays, multiply by 0.49.

[#] 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_γ per 100 parent decays