^{48}Mn β^+ decay (157.7 ms) 1991Sz03,1987Se07

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Jun Chen	NDS 179, 1 (2022)	30-Nov-2021

Parent: ^{48}Mn: E=0.0; $J^\pi=4^+$; $T_{1/2}$=157.7 ms *22*; Q(β^+)=13525 *10*; %β^+ decay=100.0

^{48}Mn-$T_{1/2}$: From Adopted Levels of ^{48}Mn, taken as weighted average of 158.1 ms *22* (1991Sz03) and 150 ms *10* (1987Se07).

^{48}Mn-Q(β^+): From 2021Wa16.

^{48}Mn-%β^+ decay: Adopted %β^+p=0.28 *4*, taken from 1991Sz03. Other: 0.27 *12* from 1987Se07.

1991Sz03: ^{48}Mn ions were produced via ^{12}C(^{40}Ca,p3n) reaction with ^{40}Ca beam from the UNILAC at GSI. γ rays were detected with two HPGe detectors and β-delayed protons were detected with two surface-barrier Si detector telescopes. Measured Eγ, Iγ, γ(t), β-delayed protons. Deduced levels, J, π, parent $T_{1/2}$, β-decay branching ratios, log *ft*, B(GT).

1987Se07: ^{48}Mn ions were produced by fusion-evaporation of 11.7 MeV/nucleon ^{40}Ca beam from the UNILAC at GSI with a 12.4 mg/cm^2 tungsten window and a 27 mg/cm^2 graphite catcher as reaction target (E=9.8 MeV/nucleon on target) and directed onto an aluminized mylar tape. γ rays were detected with a Ge(Li) detector and β particles were detected with a thin 4π plastic scintillator for β and γ singles, with two HPGe detectors and a 2π scintillator for $\beta\gamma\gamma$ measurements. For charged-particle measurements, ions were implanted into a 43 μg/cm^2 carbon foil in front of a telescope of two surface-barrier Si detectors. Measured Eγ, Iγ, $\beta\gamma$-coin, $\gamma\gamma$-coin, $\beta\gamma\gamma$-coin, $\beta\gamma$(t), β-delayed proton decay. Deduced levels, J, π, parent $T_{1/2}$, β-decay branching ratios, log *ft*, B(GT). Comparisons with shell-model calculations.

The decay scheme is based on $\gamma\gamma$-coincidences and summing relation, and halflife measurements in 1987Se07. The decay scheme could be incomplete due to a large gap between Q-value=13525 *10* (2021Wa16) and the highest observed level at E=5793. The proton separation of ^{48}Cr is S(p)=8103 *7* (2021Wa16).

^{48}Cr Levels

E(level)[†]	J^π[‡]	$T_{1/2}$[‡]	Comments
0.0	0^+	21.56 h *3*	%ε+%β^+=100
752.11 *20*	2^+		
1858.2 *3*	4^+		
3444.8 *4*	6^+		E(level): from the Adopted Levels. If placement of 87γ from 3533 level is correct, this state will be fed.
3533.2 *4*	$4^{(-)}$		
4063.9 *5*	$5^{(-)}$		
4428.5 *4*	4^+		
4652.8 *4*	$(3,4)^+$		
5032.4 *4*	$(3,4)^+$		
5293.8 *7*	$3^+,4^+,5^+$		
5608.2? *5*	$(3^+,4^+)$		
5792.5 *3*	4^+		

[†] From a least-squares fit to γ-ray energies.
[‡] From Adopted Levels.

ε,β^+ radiations

4.6≤log *ft*≤4.9 above 9.4 MeV excitation energy from delayed proton intensities per 250 keV interval (1991Sz03).

E(decay)	E(level)	Iβ^+[‡]	Iε[‡]	Log *ft*	I($\varepsilon+\beta^+$)[†‡]	Comments
(7733 *10*)	5792.5	58.3 *21*	0.0575 *22*	3.49 *2*	58.4 *21*	av Eβ=3152.6 *50*; εK=0.000878 *4*; εL=9.12×10^{-5} *4*; εM+=1.581×10^{-5} *7*
(7917[#] *10*)	5608.2?	1.63 *23*	0.00148 *21*	5.1 *1*	1.63 *23*	av Eβ=3243.4 *50*; εK=0.000810 *4*; εL=8.42×10^{-5} *4*; εM+=1.459×10^{-5} *7*

Continued on next page (footnotes at end of table)

^{48}Mn β^+ decay (157.7 ms) 1991Sz03,1987Se07 (continued)

ϵ,β^+ radiations (continued)

E(decay)	E(level)	Iβ^+[‡]	Iε[‡]	Log *ft*	I($\varepsilon+\beta^+$)[†‡]	Comments
(8231 *10*)	5293.8	3.1 *4*	0.0025 *3*	4.9 *1*	3.1 *4*	av Eβ=3398.4 *50*; εK=0.000710 *3*; εL=7.38×10^{-5} *3*; εM+=1.278×10^{-5} *6*
(8493 *10*)	5032.4	8.3 *7*	0.0059 *5*	4.56 *4*	8.3 *7*	av Eβ=3527.3 *50*; εK=0.000639 *3*; εL=6.64×10^{-5} *3*; εM+=1.150×10^{-5} *5*
(8872 *10*)	4652.8	3.9 *9*	0.0024 *6*	5.0 *1*	3.9 *9*	av Eβ=3714.8 *50*; εK=0.0005517 *2*; εL=5.733×10^{-5} *22*; εM+=9.93×10^{-6} *4*
(9097 *10*)	4428.5	10.0 *22*	0.0057 *13*	4.6 *1*	10.0 *22*	av Eβ=3825.6 *50*; εK=0.0005075 *1*; εL=5.274×10^{-5} *20*; εM+=9.14×10^{-6} *4*
(9992[#] *10*)	3533.2	<0.2		>6.6	<0.2	av Eβ=4268.7 *50*
(11667 *10*)	1858.2	5.9 *24*	0.0015 *6*	5.4 *2*	5.9 *24*	av Eβ=5099.8 *50*; εK=0.0002238 *7*; εL=2.325×10^{-5} *7*; εM+=4.027×10^{-6} *12*
(12773[#] *10*)	752.11					I($\varepsilon+\beta^+$): from intensity balancing the evaluator obtains $I_{\varepsilon+\beta+}$=9 *5* (1991Sz03 obtained 9.9 *114*), which would result in a log *ft*=5.5 inconsistent with ΔJ=2 and $\Delta\pi$=no (2nd forbidden) of this decay branch if existing. As explained in 1991Sz03, this decay branch is negligible and this mismatch in intensity balance is most probably due to unobserved high-energy transitions to the 752 level from levels above E=5793 that are populated but not seen in the decay measurements due to Pandemonium effect.

[†] From γ+ce intensity balance at each level. See comments for the significant mismatch at the 752 level, most probably due to unobserved high-energy transitions, which could have negligible impacts on the feedings to other levels high above the 752 level.
[‡] Absolute intensity per 100 decays.
[#] Existence of this branch is questionable.

^{48}Mn β^+ decay (157.7 ms) 1991Sz03,1987Se07 (continued)

$\gamma(^{48}Cr)$

Iγ normalization: Absolute intensities are obtained by normalizing relative intensities to Iγ(752)=99.7%, obtained from %β^+p=0.28 *4* from simultaneous measurement of protons and ^{48}Cr 752γ in 1991Sz03, with the 752γ being the only transition to 0^+ ground state. Although there could be unobserved transitions from high-lying states due to Pandemonium effect, it is unlikely that there could be transitions among them to directly feed the 0^+ ground state due to possible large spin differences. Therefore, %Iγ=(752)=99.7 is considered firmly determined.

E$_\gamma$[‡]	I$_\gamma$[&b]	E$_i$(level)	J$_i^\pi$	E$_f$	J$_f^\pi$	Mult.[a]	δ[a]	α[†]	Comments
87[@c]	0.21	3533.2	$4^{(-)}$	3444.8	6^+	[M2]		0.447 *6*	α(K)=0.399 *6*; α(L)=0.0429 *6*; α(M)=0.00564 *8* α(N)=0.0001953 *27* I$_\gamma$: from adopted Iγ(87)/Iγ(1675)=10/100 and Iγ(1675)=2.11.
531.0 *5*	0.54 *11*	4063.9	$5^{(-)}$	3533.2	$4^{(-)}$	M1+E2	0.24 *3*	0.000476 *9*	α=0.000476 *9*; α(K)=0.000431 *8*; α(L)=4.00×10^{-5} *8*; α(M)=5.27×10^{-6} *10* α(N)=1.97×10^{-7} *4* I$_\gamma$: weighted average of 0.8 *4* (1987Se07) and 0.52 *11* (1991Sz03).
752.1 *2*	99.7 *60*	752.11	2^+	0.0	0^+	E2		0.000325 *5*	α=0.000325 *5*; α(K)=0.000294 *4*; α(L)=2.73×10^{-5} *4*; α(M)=3.59×10^{-6} *5* α(N)=1.337×10^{-7} *19* I$_\gamma$: from 1991Sz03. All values in 1987Se07 have been re-normalized to this value.
760.2 *2*	3.18 *24*	5792.5	4^+	5032.4	$(3,4)^+$				I$_\gamma$: weighted average of 3.0 *3* (1987Se07) and 3.30 *24* (1991Sz03).
1106.1 *2*	39.3 *16*	1858.2	4^+	752.11	2^+	E2		0.0001234 *17*	α=0.0001234 *17*; α(K)=0.0001107 *16*; α(L)=1.024×10^{-5} *14*; α(M)=1.347×10^{-6} *19* α(N)=5.05×10^{-8} *7*; α(IPF)=1.097×10^{-6} *17* I$_\gamma$: weighted average of 39.4 *16* (1987Se07) and 39.2 *24* (1991Sz03).
1139.7 *2*	6.67 *44*	5792.5	4^+	4652.8	$(3,4)^+$				I$_\gamma$: weighted average of 6.9 *5* (1987Se07) and 6.49 *44* (1991Sz03).
1364.0 *2*	22.3 *11*	5792.5	4^+	4428.5	4^+				I$_\gamma$: weighted average of 22.5 *11* (1987Se07) and 21.9 *14* (1991Sz03).
1586.4[@]	0.31	3444.8	6^+	1858.2	4^+	E2		0.0001789 *25*	α=0.0001789 *25*; α(K)=5.10×10^{-5} *7*; α(L)=4.70×10^{-6} *7*; α(M)=6.19×10^{-7} *9* α(N)=2.329×10^{-8} *33*; α(IPF)=0.0001226 *17* I$_\gamma$: deduced from γ+ce intensity balance and Iγ(87)=0.211.
1675.0 *4*	2.11 *14*	3533.2	$4^{(-)}$	1858.2	4^+	(E1(+M2))	−0.01 *5*	0.000427 *6*	α=0.000427 *6*; α(K)=2.50×10^{-5} *4*; α(L)=2.30×10^{-6} *4*; α(M)=3.02×10^{-7} *5* α(N)=1.140×10^{-8} *18*; α(IPF)=0.000399 *6* I$_\gamma$: weighted average of 2.1 *2* (1987Se07) and 2.11 *14* (1991Sz03).
1728.8 *5*	1.30 *18*	5792.5	4^+	4063.9	$5^{(-)}$				I$_\gamma$: from 1991Sz03. Other: ≈0.9 *3* (1987Se07).

$^{48}_{24}Cr_{24}$-3

^{48}Mn β^+ decay (157.7 ms) 1991Sz03,1987Se07 (continued)

$\gamma(^{48}Cr)$ (continued)

E_γ[‡]	I_γ[&][b]	E_i(level)	J_i^π	E_f	J_f^π	Comments
2259.2 *5*	1.64 *19*	5792.5	4^+	3533.2	$4^{(-)}$	I_γ: weighted average of 1.9 *5* (1987Se07) and 1.60 *19* (1991Sz03).
2570.2 *5*	1.59 *18*	4428.5	4^+	1858.2	4^+	I_γ: weighted average of 1.7 *5* (1987Se07) and 1.58 *18* (1991Sz03).
3174.1 *5*	2.28 *31*	5032.4	$(3,4)^+$	1858.2	4^+	I_γ: weighted average of 2.4 *6* (1987Se07) and 2.25 *31* (1991Sz03).
3435.5 *6*	3.08 *38*	5293.8	$3^+,4^+,5^+$	1858.2	4^+	I_γ: weighted average of 2.6 *8* (1987Se07) and 3.19 *38* (1991Sz03).
3676.2 *4*	30.7 *19*	4428.5	4^+	752.11	2^+	I_γ: weighted average of 31.5 *31* (1987Se07) and 30.4 *19* (1991Sz03).
3750.0[#][c]	1.09 *20*	5608.2?	$(3^+,4^+)$	1858.2	4^+	
3900.5 *5*	10.6 *7*	4652.8	$(3,4)^+$	752.11	2^+	I_γ: weighted average of 11.2 *13* (1987Se07) and 10.44 *69* (1991Sz03).
3934.1 *5*	23.3 *16*	5792.5	4^+	1858.2	4^+	I_γ: weighted average of 24.4 *27* (1987Se07) and 22.9 *16* (1991Sz03).
4280.1 *5*	9.15 *56*	5032.4	$(3,4)^+$	752.11	2^+	I_γ: weighted average of 9.8 *18* (1987Se07) and 9.09 *56* (1991Sz03).
4856.1[#][c]	0.54 *10*	5608.2?	$(3^+,4^+)$	752.11	2^+	
5040.5[c] *10*	<1.3	5792.5	4^+	752.11	2^+	E_γ,I_γ: from 1987Se07, observed dominantly due to $\gamma\gamma$ summing effects (1987Se07).

† Additional information 1.
‡ From 1987Se07, unless otherwise noted.
# From 1991Sz03 only. Placement of these two transitions is based on their energy difference which corresponds to the 1106γ deexciting the 1858, 4^+ state.
@ Rounded values from Adopted Gammas; not observed in decay measurements in this dataset.
& From weighted average of values from 1991Sz03 and 1987Se07 where available. Values quoted as from 1987Se07 are from re-normalization of the original intensities relative to Iγ(752)=100, renormalized to Iγ=(752)=99.7 by the evaluator.
[a] From the Adopted Gammas.
[b] Absolute intensity per 100 decays.
[c] Placement of transition in the level scheme is uncertain.

$^{48}_{24}Cr_{24}$-4

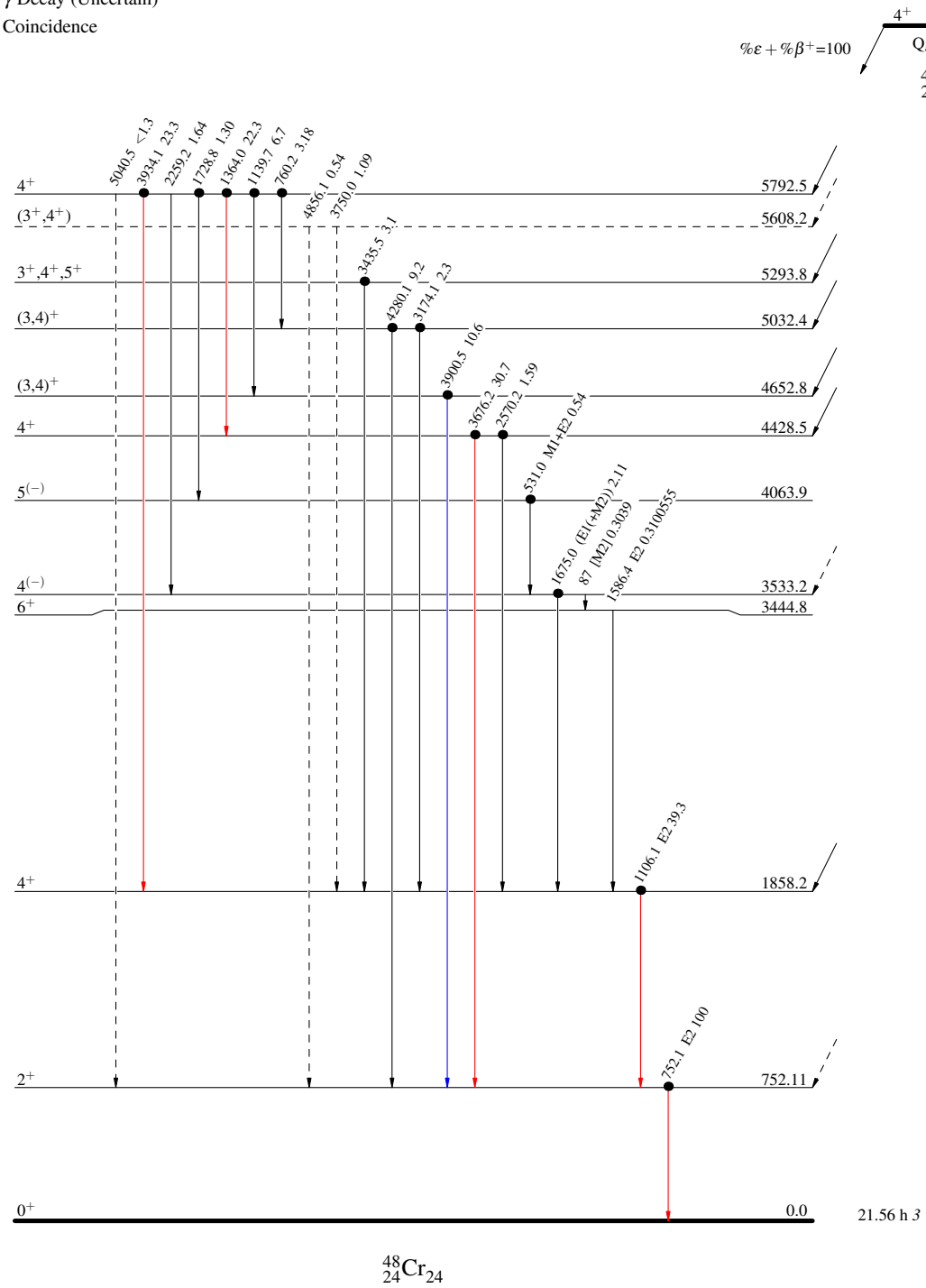
^{48}Mn β^+ decay (157.7 ms) 1991Sz03,1987Se07

Legend

- $I_\gamma < 2\% \times I_\gamma^{max}$
- $I_\gamma < 10\% \times I_\gamma^{max}$
- $I_\gamma > 10\% \times I_\gamma^{max}$
- γ Decay (Uncertain)
- Coincidence

Decay Scheme

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



	Iβ+	Iε	Log *ft*
5792.5	58.3	0.0575	3.49
5608.2	1.63	0.00148	5.1
5293.8	3.1	0.0025	4.9
5032.4	8.3	0.0059	4.56
4652.8	3.9	0.0024	5.0
4428.5	10.0	0.0057	4.6
3533.2	<0.2		>6.6
1858.2	5.9	0.0015	5.4