

$^{59}\text{Mn}$   $\beta^-$  decay 2001Oi02,1977Pa18

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	M. Shamsuzzoha Basunia		NDS 151, 1 (2018)	1-Apr-2018

Parent:  $^{59}\text{Mn}$ :  $E=0.0$ ;  $J^\pi=5/2^-$ ;  $T_{1/2}=4.59$  s 5;  $Q(\beta^-)=5139.5$  24;  $\% \beta^-$  decay=100.0

**2001Oi02**: source from 1 GeV pulsed proton spallation of Nb, mass separation;  $\beta$  telescope (planar Ge + scin), coaxial Ge; measured  $E\gamma$ ,  $I\gamma$ ,  $I\beta(\text{total})$ ,  $I\beta(t)$ ,  $\beta\gamma$  coin.

**1977Pa18**: sources from  $^{48}\text{Ca}(^{13}\text{C},\text{pn})$ ,  $E=26$  MeV; Ge(Li) and scintillation detectors, enriched target (96.8%), coin resolving time=30 ns; measured  $\gamma(t)$ ,  $E\gamma$ ,  $I\gamma$ ,  $\gamma\gamma$  coin,  $\beta\gamma$  coin.

 $^{59}\text{Fe}$  Levels

E(level) <sup>†</sup>	$J^\pi$ <sup>‡</sup>	$T_{1/2}$	Comments
0.0	$3/2^-$	44.495 d 9	$T_{1/2}$ : from Adopted Levels.
287.04 11	$1/2^-$		
472.72 14	$5/2^-$		
570.75 15	$5/2^-$		
726.28 13	$3/2^-$		
1023.1 4	$7/2^-$		
1078?			E(level): rounded value from Adopted Levels.
1161.85 15	$3/2^-$		
1569.4 7	$5/2^-$		
1750?			E(level): rounded value from Adopted Levels.
1918.2 8	$3/2, 5/2^+$		
1961.3?	$1/2^-$		
2349.0 9	$(7/2)^-$		
2447.0 10	$(3/2)$		

<sup>†</sup> From least-squares adjustment of  $E\gamma$ .

<sup>‡</sup> From Adopted Levels.

 $\beta^-$  radiations

E(decay)	E(level)	$I\beta^{-\dagger\ddagger}$	Log $ft$	Comments
(2693 3)	2447.0	0.18 4	6.30 11	av $E\beta=1142.3$ 13
(2791 3)	2349.0	0.29 7	6.16 12	av $E\beta=1189.0$ 13
(3221 3)	1918.2	0.082 22	6.98 13	av $E\beta=1395.2$ 13
(3570.1 25)	1569.4	0.35 8	6.55 11	av $E\beta=1563.1$ 12
(3977.6 24)	1161.85	10.5 15	5.28 8	av $E\beta=1760.1$ 12
(4116.4 24)	1023.1	0.18 10	7.11 25	E(decay): 3860 160 (1977Pa18). av $E\beta=1827.4$ 12
(4413.2 24)	726.28	32 5	4.99 9	Additional information 1. av $E\beta=1971.4$ 12
(4568.8 24)	570.75	10.9 20	5.53 10	E(decay): 4380 150 (1977Pa18). av $E\beta=2047.0$ 12
(4666.8 24)	472.72	21 4	5.29 10	E(decay): 4650 200 (1977Pa18). av $E\beta=2094.7$ 12
(4852.5 <sup>#</sup> 24)	287.04	0.4 4	7.1 5	E(decay): 4680 180 (1977Pa18). av $E\beta=2185.0$ 12
(5139.5 24)	0.0	23 8	5.44 16	av $E\beta=2324.8$ 12

<sup>†</sup>  $\beta^-$  branching obtained from  $I\gamma$  imbalance at each level and total  $I\beta$  measured by 2001Oi02.

<sup>‡</sup> Absolute intensity per 100 decays.

<sup>#</sup> Existence of this branch is questionable.

$^{59}\text{Mn} \beta^-$  decay **2001Oi02,1977Pa18** (continued) $\gamma(^{59}\text{Fe})$ 

I $\gamma$  normalization: from  $\Sigma$  (I( $\gamma$ +ce) to g.s.)=77% 8. The latter is based on I $\beta$ (total)=316.5 5 relative to I(726 $\gamma$ )=100 10 (2001Oi02) and  $\Sigma$  (I( $\gamma$ +ce) to g.s.)=245 7 relative to I(726 $\gamma$ )=100. 1977Pa18 estimate a 51% g.s. branch, based on Nilsson model and on the observed feeding of the 5/2- 473-keV level, assuming the latter to be the second member of a K=3/2 band based on the g.s.

$E_\gamma$ <sup>†</sup>	$I_\gamma$ <sup>†b</sup>	$E_i$ (level)	$J_i^\pi$	$E_f$	$J_f^\pi$	Mult. <sup>‡</sup>	$\alpha^c$	Comments
<sup>x</sup> 191 <sup>a</sup> 287.03 13	12.3 10	287.04	1/2 <sup>-</sup>	0.0	3/2 <sup>-</sup>	[M1,E2]	0.006 4	%I $\gamma$ =3.9 6 $\alpha$ =0.006 4; $\alpha$ (K)=0.005 3; $\alpha$ (L)=0.0005 3 I $\gamma$ : from weighted average of 12.9 10 (1977Pa18) and 11.0 14 (2001Oi02). Uncertainty lowest input value.
439.22 16	3.8 6	726.28	3/2 <sup>-</sup>	287.04	1/2 <sup>-</sup>			%I $\gamma$ =1.19 23 I $\gamma$ : from weighted average of 4.5 13 (1977Pa18) and 3.7 6 (2001Oi02). Uncertainty lowest input value.
452.8 11	0.38 <sup>&amp;</sup> 25	1023.1	7/2 <sup>-</sup>	570.75	5/2 <sup>-</sup>	(M1+E2)		%I $\gamma$ =0.12 8
472.74 15	69 <sup>#</sup> 5	472.72	5/2 <sup>-</sup>	0.0	3/2 <sup>-</sup>	(M1+E2)	0.0012 5	%I $\gamma$ =22 3 $\alpha$ =0.0012 5; $\alpha$ (K)=0.0011 4; $\alpha$ (L)=0.00011 4
570.76 16	58 4	570.75	5/2 <sup>-</sup>	0.0	3/2 <sup>-</sup>	(M1+E2)	0.00072 21	%I $\gamma$ =18.2 22 $\alpha$ =0.00072 21; $\alpha$ (K)=0.00064 18 I $\gamma$ : from weighted average of 59 4 (1977Pa18) and 53 8 (2001Oi02).
591.1 3	22.5 <sup>#</sup> 18	1161.85	3/2 <sup>-</sup>	570.75	5/2 <sup>-</sup>			%I $\gamma$ =7.1 10
689.2 3	0.81 19	1161.85	3/2 <sup>-</sup>	472.72	5/2 <sup>-</sup>			%I $\gamma$ =0.25 7
(697 <sup>@</sup> )	0.07 <sup>@</sup> 2	2447.0	(3/2)	1750?				%I $\gamma$ =0.022 7
726.30 17	100 <sup>#</sup>	726.28	3/2 <sup>-</sup>	0.0	3/2 <sup>-</sup>			%I $\gamma$ =31 4
(841 <sup>@</sup> )	0.028 <sup>@</sup> 8	1918.2	3/2,5/2 <sup>+</sup>	1078?				%I $\gamma$ =0.009 3
874.82 19	6.8 8	1161.85	3/2 <sup>-</sup>	287.04	1/2 <sup>-</sup>			%I $\gamma$ =2.1 4 I $\gamma$ : from weighted average of 6.7 8 (1977Pa18) and 6.9 10 (2001Oi02). Uncertainty lowest input value.
1023.0 4	0.21 <sup>&amp;</sup> 16	1023.1	7/2 <sup>-</sup>	0.0	3/2 <sup>-</sup>			%I $\gamma$ =0.07 5
1161.7 3	3.6 6	1161.85	3/2 <sup>-</sup>	0.0	3/2 <sup>-</sup>			%I $\gamma$ =1.13 23 Other I $\gamma$ : 1.7 7 (1977Pa18), inconsistent with branching from 2001Oi02 and from (n, $\gamma$ ).
(1193 <sup>@</sup> )	0.027 <sup>@</sup> 8	1918.2	3/2,5/2 <sup>+</sup>	726.28	3/2 <sup>-</sup>			%I $\gamma$ =0.008 3
1235 <sup>d</sup>	<0.05	1961.3?	1/2 <sup>-</sup>	726.28	3/2 <sup>-</sup>			%I $\gamma$ =0.008 8
<sup>x</sup> 1545	<0.08							E $\gamma$ : matches that for a known 2757 level to 1211 level transition, but the expected 1211 $\gamma$ deexciting the 1211 level is not observed.
1569.4 7	1.13 19	1569.4	5/2 <sup>-</sup>	0.0	3/2 <sup>-</sup>			%I $\gamma$ =0.35 7
(1720 <sup>@</sup> )	0.11 <sup>@</sup> 3	2447.0	(3/2)	726.28	3/2 <sup>-</sup>			%I $\gamma$ =0.035 11
1918.2 8	0.21 6	1918.2	3/2,5/2 <sup>+</sup>	0.0	3/2 <sup>-</sup>			%I $\gamma$ =0.066 21
<sup>x</sup> 2020 <sup>a</sup>								
2159.9 10	0.37 10	2447.0	(3/2)	287.04	1/2 <sup>-</sup>			%I $\gamma$ =0.12 4
<sup>x</sup> 2294 <sup>a</sup>								

Continued on next page (footnotes at end of table)

$^{59}\text{Mn}$   $\beta^-$  decay 2001Oi02,1977Pa18 (continued) $\gamma(^{59}\text{Fe})$  (continued)

$E_\gamma^\dagger$	$I_\gamma^{\ddagger b}$	$E_i(\text{level})$	$J_i^\pi$	$E_f$	$J_f^\pi$	Comments
2348.9 9	0.93 18	2349.0	(7/2) <sup>-</sup>	0.0	3/2 <sup>-</sup>	%I $\gamma$ =0.29 7
(2448 @)	0.040 @ 12	2447.0	(3/2)	0.0	3/2 <sup>-</sup>	%I $\gamma$ =0.013 4

<sup>†</sup> From 2001Oi02, except as noted. 2001Oi02 quote  $I_\gamma$  relative to  $I(726\gamma)=100$  10; the uncertainties given here are those reported in 2001Oi02 combined in quadrature with the 10% uncertainty in  $I(726\gamma)$ .

<sup>‡</sup> From Adopted Gammas. Sign assumed by evaluator for D+Q and D in Adopted Gammas.

# From 1977Pa18; relative to  $I(726\gamma)=100$ .

@  $E_\gamma$  is rounded value from adopted gammas;  $I_\gamma$  is based on  $I_\gamma$  for strongest  $\gamma$  observed to deexcite the same level and adopted branching from that level.  $\gamma$  not seen in decay.

& Adopted  $I(453\gamma):I(1023\gamma)=73$  6:100 6 cf. 0.38 25:0.21 16 here.

<sup>a</sup> Observed by 2001Oi02; assignment to  $^{59}\text{Mn}$   $\beta^-$  decay is likely since that was the only activity produced for A=59.

<sup>b</sup> For absolute intensity per 100 decays, multiply by 0.31 4.

<sup>c</sup> Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on  $\gamma$ -ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

<sup>d</sup> Placement of transition in the level scheme is uncertain.

<sup>x</sup>  $\gamma$  ray not placed in level scheme.

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Decay Scheme

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

Legend

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

