^{31}Mg β^- decay (270 ms) 2005Ma86,1993Kl02,1984Gu19

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Jun Chen and Balraj Singh	NDS 184, 29 (2022)	24-Jun-2022

Parent: ^{31}Mg: E=0; J$^\pi$=1/2$^+$; T$_{1/2}$=270 ms *2*; Q(β^-)=11829 *4*; %β^- decay=100.0
^{31}Mg-J$^\pi$,T$_{1/2}$: From Adopted Levels of ^{31}Mg.
^{31}Mg-Q(β^-): From 2021Wa16.
^{31}Mg-%β^- decay: %β^-n=6.2 *19* (2008ReZZ,1995ReZZ). Note that %β^-n=1.7 *3* (1984La03) is also reported.
2005Ma86: ^{31}Mg source was produced via Be(^{36}S,X) with 77.5 MeV/nucleon ^{36}S beam on a 1014 μg-thick Be target at GANIL. Fragments were analyzed and separated by the LISE3 spectrometer and implanted into a DSSD detector. γ rays were detected with 3 Clover Ge detectors and one low-energy photon spectrometer (LEPS). Measured Eγ, Iγ, $\beta\gamma$-coin, $\beta\gamma\gamma$-coin, fragment-β time correlation. Deduced levels, parent T$_{1/2}$, J, π, β-decay branching ratios, log *ft*, B(GT). Comparisons with theoretical calculations.
Additional information 1.
1993Kl02: Mg isotopes were produced by bombarding an Uranium Carbide target with 600 MeV protons from the CERN synchrocyclotron and separated by the ISOLDE2 separator. β particles were detected with a thin plastic scintillator, neutrons were detected with an efficient detector, and γ rays were detected with two Ge detectors. Measured Eγ, Iγ, $\beta\gamma$-coin, $\beta\gamma\gamma$-coin, $\beta\gamma$-n-coin. Deduced levels, J, π, branching ratios, log *ft*.
1984Gu19: Mg isotopes were produced by bombarding a 30 g/cm^2 Iridium target with 10 GeV proton beam from the CERN synchrotron. Fragments were separated and collected into a thin stainless steel tube. γ rays were detected with two Ge(Li) detectors and β particles were detected with two plastic scintillators. Measured Eγ, Iγ, $\beta\gamma$(t), $\beta\gamma$-coin, $\beta\gamma\gamma$-coin. Deduced levels, T$_{1/2}$, γ-ray branching ratios, β-delayed neutron-emission probabilities. Other papers from the same group with the same experimental setup are 1984La03: measured %β^-n, and 1979De02: measured 5 γ ray energies and intensities.
Other: 1977Bu11.

^{31}Al Levels

E(level)†	J$^\pi$‡	T$_{1/2}$‡	Comments
0.0	5/2$^{(+)}$	644 ms *25*	
946.7 *4*	1/2$^{(+)}$,3/2		
1613.0 *3*	1/2$^+$,3/2$^+$		
3239.3 *5*	1/2$^+$,3/2$^+$		
3433.3 *5*	1/2$^+$,3/2$^+$		
3623.0 *6*	1/2$^+$,3/2$^+$		
4143.3 *4*	1/2$^+$,3/2$^+$		
4563.7 *5*	1/2$^+$,3/2$^+$		
4640.4 *11*	1/2$^+$,3/2$^+$		
4809.1? *15*			E(level): reported in 1993Kl02 and 1984Gu19. This level was not seen in the coincidence measurements or in the un-gated γ-spectrum (2005Ma86).
5046.5 *14*	1/2$^+$,3/2$^+$		
5149.7 *11*	1/2$^+$,3/2$^+$		
7157.9+x			E(level): x<4671 *5* from Q(β^-)(^{31}Mg)-S(n)(^{31}Al), where Q(β^-)=11829 *4* and S(n)=7157.9 *30* from 2021Wa16. This represents a range of unobserved levels that subsequently decay to ^{30}Mg via one-neutron emission.

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

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β^- radiations

E(decay)	E(level)	Iβ^- †‡	Log *ft*	Comments
(2.3×10^3 @ *23*)	7157.9+x	6.2 *19*		Iβ^-: from adopted %β^-n=6.2 *19* for the decay of ^{31}Mg g.s.
(6679 *4*)	5149.7	2.9 *5*	5.4 *1*	av Eβ=3107.6 *21*
(6783 *4*)	5046.5	3.5 *9*	5.3 *1*	av Eβ=3158.5 *21*
(7020# *4*)	4809.1?	1.0 *3*	5.9 *1*	av Eβ=3275.5 *21*
(7189 *4*)	4640.4	1.6 *4*	5.8 *1*	av Eβ=3358.7 *21*
(7265 *4*)	4563.7	7.9 *10*	5.1 *1*	av Eβ=3396.5 *20*
(7686 *4*)	4143.3	12.5 *13*	5.0 *1*	av Eβ=3603.9 *20*
(8206 *4*)	3623.0	11.3 *12*	5.2 *1*	av Eβ=3860.7 *20*
(8396 *4*)	3433.3	11.3 *17*	5.2 *1*	av Eβ=3954.4 *20*
(8590 *4*)	3239.3	28.8 *24*	4.88 *4*	av Eβ=4050.2 *20*
(10216 *4*)	1613.0	10.6 *20*	5.7 *1*	av Eβ=4853.5 *20*
(10882 *4*)	946.7	5.2 *27*	6.1 *2*	av Eβ=5182.7 *20*

† From Iγ intensity balance at each level.
‡ Absolute intensity per 100 decays.
# Existence of this branch is questionable.
@ Estimated for a range of levels.

γ(^{31}Al)

Iγ normalization: scaled from the original value of 0.368 in 2005Ma86 by a factor of f1*f2 with f1=127.7/100 due to renormalization of Iγ(1612.8γ) from 127.7 *93* in 2005Ma86 to 100 in this dataset by the evaluators, in order to align intensities from 2005Ma86 relative to Iγ(946.7γ)=100 with those from other studies (1984Gu19,1993Kl02) relative to Iγ(1612.8γ)=100, and f2=(100-6.2)/(100-1.7) accounting for the change of %β_n for ^{31}Mg used in obtaining the total number of ^{31}Mg from measured γ intensities, from 1.7 *3* quoted in 2005Ma86 to the adopted 6.2 *19*. The original value of 0.368 in 2005Ma86 is obtained by using absolute intensities deduced from the total number of ^{31}Mg which is derived from measured intensities of five γ-rays (not reported in 2005Ma86) from the decay of ^{31}Al to ^{31}Si and previously known ^{31}Al decay scheme. By assuming Σ(Iγ to g.s.)=93.8% *19* from 100−%I$_{\beta n}$ (6.2 *19* from Adopted Levels of ^{31}Mg) with no β branch to the g.s. for ΔJ=2, $\Delta\pi$=no transition and with no unobserved γ transitions to g.s., the evaluators obtain 0.440 *3*. Others: 0.39 *8* (1993Kl02) and 0.36 *11* (1984Gu19), deduced by evaluators from the ratios of absolute intensities to relative intensities in each reference, which are significantly different and appear to be less reliable because of an overestimate of the β feeding to the ground state, and incomplete level schemes compared to that of 2005Ma86.

E$_\gamma$ †	I$_\gamma$ †#	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	Comments
665.9 *7*	31.4 *20*	1613.0	1/2$^+$,3/2$^+$	946.7	1/2$^{(+)}$,3/2	%Iγ=14.1 *14* E$_\gamma$: weighted average of 666.2 *7* (1993Kl02), 665.5 *8* (1984Gu19), and 665.7 *13* (2005Ma86). I$_\gamma$: weighted average of 34.0 *24* (1993Kl02), 29.4 *20* (1984Gu19), and 32.4 *37* (2005Ma86).
903.8 *8*	5.1 *7*	4143.3	1/2$^+$,3/2$^+$	3239.3	1/2$^+$,3/2$^+$	%Iγ=2.3 *4* E$_\gamma$: weighted average of 904.0 *8* (1993Kl02), 903.7 *12* (1984Gu19), and 903.6 *11* (2005Ma86). I$_\gamma$: unweighted average of 5.3 *6* (1993Kl02), 6.3 *10* (1984Gu19), and 3.8 *4* (2005Ma86).
946.7 *5*	82 *5*	946.7	1/2$^{(+)}$,3/2	0.0	5/2$^{(+)}$	%Iγ=37 *4* E$_\gamma$: weighted average of 946.6 *5* (1993Kl02), 946.9 *10* (1984Gu19), and 947.0 *10* (2005Ma86). I$_\gamma$: weighted average of 78.3 *56* (1993Kl02), 87.5 *50* (1984Gu19), and 78.3 *57* (2005Ma86).

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^{31}Mg β^- decay (270 ms) 2005Ma86,1993Kl02,1984Gu19 (continued)

$\gamma(^{31}Al)$ (continued)

E_γ [†]	I_γ [†#]	E_i(level)	J^π_i	E_f	J^π_f	Comments
1612.8 *4*	100	1613.0	1/2+,3/2+	0.0	5/2(+)	%Iγ=44.8 *34* E_γ: weighted average of 1612.8 *4* (1993Kl02), 1612.8 *6* (1984Gu19), and 1612.9 *8* (2005Ma86).
1626.2 *5*	68.1 *18*	3239.3	1/2+,3/2+	1613.0	1/2+,3/2+	%Iγ=30.5 *25* E_γ: weighted average of 1626.2 *5* (1993Kl02), 1626.2 *6* (1984Gu19), and 1626.4 *12* (2005Ma86). I_γ: weighted average of 63.6 *46* (1993Kl02), 68.8 *18* (1984Gu19), and 67.3 *71* (2005Ma86).
1820.0 *8*	11.1[‡] *20*	3433.3	1/2+,3/2+	1613.0	1/2+,3/2+	%Iγ=5.0 *10* E_γ: weighted average of 1820.0 *8* (1993Kl02), 1820.0 *9* (1984Gu19), and 1820.1 *11* (2005Ma86). I_γ: unweighted average of 8.8 *12* (1993Kl02), 9.4 *11* (1984Gu19), and 15.0 *18* (2005Ma86).
2291.7 *14*	1.17 *25*	3239.3	1/2+,3/2+	946.7	1/2(+),3/2	%Iγ=0.52 *12*
2487.4 *12*	4.1 *7*	3433.3	1/2+,3/2+	946.7	1/2(+),3/2	%Iγ=1.84 *34* E_γ: weighted average of 2487.6 *15* (1993Kl02), 2487.5 *18* (1984Gu19), and 2487.3 *12* (2005Ma86). I_γ: weighted average of 4.8 *8* (1993Kl02), 3.8 *10* (1984Gu19), and 3.7 *7* (2005Ma86).
2529.7 *9*	8.9 *9*	4143.3	1/2+,3/2+	1613.0	1/2+,3/2+	%Iγ=4.0 *5* E_γ: weighted average of 2529.8 *10* (1993Kl02), 2529.8 *9* (1984Gu19), and 2529.5 *10* (2005Ma86). I_γ: weighted average of 8.7 *9* (1993Kl02), 8.8 *15* (1984Gu19), and 9.8 *18* (2005Ma86).
2675.8 *9*	7.5 *8*	3623.0	1/2+,3/2+	946.7	1/2(+),3/2	%Iγ=3.4 *5* E_γ: weighted average of 2676.1 *10* (1993Kl02),2675.6 *9* (1984Gu19), and 2675.6 *13* (2005Ma86). I_γ: weighted average of 7.7 *8* (1993Kl02), 6.3 *14* (1984Gu19), and 8.7 *17* (2005Ma86).
2949.4 *10*	12.0 *12*	4563.7	1/2+,3/2+	1613.0	1/2+,3/2+	%Iγ=5.4 *7* E_γ: weighted average of 2949.0 *10* (1993Kl02), 2949.8 *10* (1984Gu19), and 2949.5 *11* (2005Ma86). I_γ: weighted average of 12.3 *12*(1993Kl02), 11.2 *16* (1984Gu19), and 13.1 *29* (2005Ma86).
3196.6 *10*	12.8 *14*	4143.3	1/2+,3/2+	946.7	1/2(+),3/2	%Iγ=5.7 *8* E_γ: weighted average of 3196.2 *10* (1993Kl02), 3197.0 *10* (1984Gu19), and 3196.5 *12* (2005Ma86). I_γ: weighted average of 13.0 *14* (1993Kl02), 11.9 *19* (1984Gu19), 14.6 *36* (2005Ma86).
3432.8 *8*	10.0 *26*	3433.3	1/2+,3/2+	0.0	5/2(+)	%Iγ=4.5 *12* E_γ: weighted average of 3431.8 *12* (1993Kl02),3433.0 *8* (1984Gu19), and 3433.3 *14* (2005Ma86). I_γ: 2005Ma86 claim two very close γ-rays from different levels, one from the 3433 level, the other from a 5046 level; the differences were unresolved by earlier experiments and all the intensity from earlier experiments is attributed to this level feeding alone. Others: 16.2 *15* (1993Kl02) and 15 *2* (1984Gu19) for unresolved doublet.
3433.3 *14*	7.7 *20*	5046.5	1/2+,3/2+	1613.0	1/2+,3/2+	%Iγ=3.5 *9*
3617.7 *12*	3.9[‡] *11*	4563.7	1/2+,3/2+	946.7	1/2(+),3/2	%Iγ=1.8 *5*
3623.0 *8*	17.8[‡] *15*	3623.0	1/2+,3/2+	0.0	5/2(+)	%Iγ=8.0 *9* E_γ: weighted average of 3621.9 *13* (1993Kl02),3623.0 *9* (1984Gu19), and 3623.4 *8* (2005Ma86). I_γ: weighted average of 18.2 *15* (1993Kl02), 16.9 *22* (1984Gu19), and 18.4 *52* (2005Ma86).
3693.0 *19*	2.9 *8*	4640.4	1/2+,3/2+	946.7	1/2(+),3/2	%Iγ=1.3 *4*

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^{31}Mg β^- decay (270 ms) 2005Ma86,1993Kl02,1984Gu19 (continued)

$\gamma(^{31}Al)$ (continued)

E_γ [†]	I_γ [†#]	E_i(level)	J_i^π	E_f	J_f^π	Comments
4143.2 *6*	1.1 *4*	4143.3	1/2$^+$,3/2$^+$	0.0	5/2$^{(+)}$	%Iγ=0.49 *18*
4202.7 *10*	6.4 *9*	5149.7	1/2$^+$,3/2$^+$	946.7	1/2$^{(+)}$,3/2	%Iγ=2.9 *5* E_γ: weighted average of 4201.1 *14* (1993Kl02), 4203.2 *10* (1984Gu19), and 4203.5 *17* (2005Ma86). I_γ: weighted average of 5.7 *9* (1993Kl02), 7.5 *12* (1984Gu19), and 7.4 *25* (2005Ma86).
4563.5 *7*	1.7 *6*	4563.7	1/2$^+$,3/2$^+$	0.0	5/2$^{(+)}$	%Iγ=0.76 *28*
4640.3 *13*	0.63 *24*	4640.4	1/2$^+$,3/2$^+$	0.0	5/2$^{(+)}$	%Iγ=0.28 *11*
4808.7[@] *15*	2.3 *6*	4809.1?		0.0	5/2$^{(+)}$	%Iγ=1.03 *28* E_γ: weighted average of 4809.0 *15* (1993Kl02) and 4808.3 *20* (1984Gu19). I_γ: weighted average of 2.3 *6* (1993Kl02) and 2.2 *12* (1984Gu19).

† From 2005Ma86, unless otherwise noted. Weighted average are taken where values from 1993Kl02 and 1984Gu19 are also available. Intensities are relative to Iγ(1612.8γ)=100. 2005Ma86 list the values as I(γ+ce), but no multipolarities are assigned. The conversion coefficients are however expected to be insignificant; thus, I(ce) values are negligible.

‡ Used value from Erratum (September 2007) by 2005Ma86 in weighted average. Value was incorrect in the original paper by 2005Ma86.

\# For absolute intensity per 100 decays, multiply by 0.448 *34*.

@ Placement of transition in the level scheme is uncertain.

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