^{24}Al ε decay (2.053 s) 1981Wa07,1979Ho08

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	M. Shamsuzzoha Basunia, Anagha Chakraborty	NDS 186, 2 (2022)	31-Mar-2022

Parent: ^{24}Al: E=0; J$^{\pi}$=4$^+$; T$_{1/2}$=2.053 s *4*; Q(ε)=13884.77 *23*; %ε+%β^+ decay=100.0

^{24}Al-J$^{\pi}$,T$_{1/2}$: From ^{24}Al Adopted Levels.

^{24}Al-Q(ε): From 2021Wa16.

Other references: 1968Ar03, 1969St14, 1971To12, 1972De28, 1979Sh11, 1985Ad10, 1994Ba54.

1981Wa07: ^{24}Al from ^{24}Mg(p,n); measured Eγ, Iγ, $\gamma\gamma$-coin; deduced log *ft*, β+ branching. Deduced excited levels, γ-branching ratios.

1979Ho08: ^{24}Al produced from ^{24}Mg(p,n). Ge(Li), Si(Au) detectors. Measured: Eγ, Iγ, Iβ, Iα. A total of 0.035% *6* α branching intensity for levels >10000 keV has been reported.

1968Ar03: Measured Eγ, Iγ. Ge(Li), a wedge-gap magnetic spectrometer, and four Si detectors.

1969St14: Measured EΓ, delayed α branching. A total of 0.0077% *10* α branching intensity for three levels above 11000 keV has been reported. Ge(Li) and Si surface barrier detectors.

1971To12: ^{24}Al produced from ^{24}Mg(p,n). Si(Au) detector. Measured β-delayed Eα, Iα.

1972De28: Measured Eγ, Iγ, deduced β feeding from γ-ray intensity balance. Ge(Li) detector.

1979Sh11: Measured Eγ, Iγ, γ branching, β branching. Ge(Li), a counter telescope of two plastic scintillators.

1985Ad10: Source obtained bombarding ^{24}Mg (enrichment 99.9%, 0.7 mm thick) target, with proton beam, E=18 MeV. Ge(Li) detector. Measured Eγ, Iγ, deduced ε+β+ feeding to the excited states in ^{24}Mg. Also 1983Ho05.

1994Ba54: Measured β-delayed proton spectra, half-life; deduced delayed proton branching ratio. Gas-ΔE, Si-E triple telescopes.

^{24}Mg Levels

E(level)†	J$^{\pi}$‡	T$_{1/2}$	Comments
0	0$^+$	stable	
1368.668 *5*	2$^+$		
4122.867 *15*	4$^+$		
4238.35 *4*	2$^+$		
5235.16 *6*	3$^+$		
6010.34 *5*	4$^+$		
7348.61 *10*	2$^+$		
7616.42 *7*	3$^-$		
7812.0 *6*	(4$^-$,5$^+$)		
8439.29 *5*	4$^+$		
9301.08 *9*	(4$^+$)		
9457.81 *4*	(3)$^+$		E(level): From Adopted Levels.
9516.18 *5*	(4)$^+$		
10575.94 *8*	(4$^+$)		
10820.8 *4*	3$^+$,4$^+$		
11216.69‡ *18*	3$^+$,4$^+$		E(level): Others: 11220 *5* (1979Ho08), 11190 *20* (1971To12), 11230 *40* (1969St14).
11314.4 *15*	(3,4)$^+$		
11698.2‡ *10*	4$^+$		E(level): Others: 11693 *5* (1979Ho08), 11680 *20* (1971To12), 11700 *30* (1969St14).
12051.3‡ *5*	4$^+$		E(level): Others: 12051 *10* (1979Ho08), 12040 *40* (1971To12).
12119.0‡ *10*	4$^+$		E(level): Others: 12119 *10* (1979Ho08), 12120 *30* (1971To12), 12130 *30* (1969St14).
12162‡ *3*	4$^+$		E(level): Others: 12158 *10* (1979Ho08), 11150 *30* (1971To12).
12975‡ *3*	4$^+$		E(level): Other: 12963 *15* (1979Ho08).

† From a least-squares fit to the γ-ray energies. 3493.3γ from 7616, 087.7γ from 9457.81, and 8146.0γ from 9516 keV level, were calculated from level energy differences with recoil corrections. The calculated Eγ was not considered in the least-squares fit.

‡ From Adopted Levels.

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ε,β^+ radiations

E(decay)	E(level)	Iβ^+ [#]	Iε[#]	Log *ft*	I(ε+β^+)[†#]	Comments
(910 *3*)	12975		2×10^{-5} *1*	5.27 *22*	2×10^{-5}[‡] *1*	εK=0.9151; εL=0.07978; εM+=0.005140
(1723 *3*)	12162	0.00069 *18*	6.2×10^{-5} *17*	5.34 *12*	7.5×10^{-4}[‡] *20*	av Eβ=282.5 *16*; εK=0.0755 *13*; εL=0.00657 *11*; εM+=0.000423 *7*
(1765.8 *10*)	12119.0	0.0009 *3*	6.9×10^{-5} *21*	5.31 *13*	1.0×10^{-3}[‡] *3*	av Eβ=301.2 *11*; εK=0.0632 *7*; εL=0.00550 *6*; εM+=0.000354 *4* I(ε+β^+): Other: 0.0004 *1* from %α in 1969St14.
(1833.5 *6*)	12051.3	0.00010 *3*	5.8×10^{-6} *16*	6.42 *12*	1.1×10^{-4}[‡] *3*	av Eβ=330.0 *10*; εK=0.0485 *5*; εL=0.00423 *4*; εM+=0.0002723 *2*
(2186.6 *10*)	11698.2	0.026 *6*	0.00046 *11*	4.67 *10*	0.026[‡] *6*	av Eβ=483.8 *12*; εK=0.01608 *11*; εL=0.001400 *10*; εM+=9.02×10^{-5} *6* I(ε+β^+): Other: 0.0049 *9* from %α in 1969St14.
(2570.4 *15*)	11314.4	0.027 *6*	0.00020 *4*	5.18 *10*	0.027 *6*	av Eβ=656.9 *13*; εK=0.00674 *4*; εL=0.000587 *4*; εM+=3.781×10^{-5} *21*
(2668.1 *3*)	11216.69	0.0072 *20*	4.4×10^{-5} *12*	5.86 *12*	0.0072[‡] *20*	av Eβ=701.6 *11*; εK=0.005600 *24*; εL=0.0004874 *2*; εM+=3.140×10^{-5} *14* I(ε+β^+): Other: 0.0024 *4* from %α in 1969St14.
(3064.0 *5*)	10820.8	0.11 *2*	0.00035 *6*	5.08 *8*	0.11 *2*	av Eβ=884.8 *11*; εK=0.002920 *10*; εL=0.0002541 *9*; εM+=1.637×10^{-5} *6*
(3308.83 *24*)	10575.94	0.67 *2*	0.0015	4.512 *14*	0.67 *2*	av Eβ=999.6 *11*; εK=0.002078 *7*; εL=0.0001808 *6*; εM+=1.165×10^{-5} *4*
(4368.59 *24*)	9516.18	35.4 *20*	0.0258 *15*	3.525 *25*	35.4 *20*	av Eβ=1504.9 *11*; εK=0.0006665 *1*; εL=5.799×10^{-5} *12*; εM+=3.735×10^{-6} *8*
(4583.69 *25*)	9301.08	2.29 *15*	0.00139 *9*	4.84 *3*	2.29 *15*	av Eβ=1608.7 *12*; εK=0.0005538 *1*; εL=4.818×10^{-5} *10*; εM+=3.104×10^{-6} *6*
(5445.48 *24*)	8439.29	49.5 *15*	0.0157 *5*	3.930 *14*	49.5 *15*	av Eβ=2027.1 *12*; εK=0.0002910 *5*; εL=2.532×10^{-5} *4*; εM+=1.631×10^{-6} *3*
(6072.8[@] *7*)	7812.0	0.014 *13*		7.7 *4*	0.014 *13*	av Eβ=2333.8 *12*
(7874.43 *24*)	6010.34	1.2 *3*		6.43 *11*	1.2 *3*	av Eβ=3221.2 *12*
(8649.61 *24*)	5235.16	1.37 *24*		6.59 *8*	1.37 *24*	av Eβ=3603.6 *12*
(9761.90 *23*)	4122.867	9 *3*		6.05 *15*	9 *3*	av Eβ=4154.7 *12*

† From γ-ray intensity balance at each level, except where otherwise noted.
‡ From measured %α branching in 1979Ho08.
# Absolute intensity per 100 decays.
@ Existence of this branch is questionable.

$\gamma(^{24}$Mg)

Iγ normalization: From ΣI$\gamma(1+\alpha)$=100 to g.s.

E$_\gamma$[†]	I$_\gamma$[†&]	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	Mult.[#]	α[@]	Comments
^{x}587.95 *6*	0.149 *8*							
775.4 *2*	0.053 *8*	6010.34	4$^+$	5235.16	3$^+$			
822.0 *6*	0.021 *8*	8439.29	4$^+$	7616.42	3$^-$	[E1]		I$_\gamma$: Other: 0.6 *2* (1972De28).
860.2[a] *6*	0.022 *11*	9301.08	(4$^+$)	8439.29	4$^+$			E$_\gamma$: Energy from level scheme. Possible doublet with unknown contaminant. Not adopted.
^{x}909.09 *6*	0.122 *6*							
996.83 *10*	0.137 *7*	5235.16	3$^+$	4238.35	2$^+$			
1059.78 *8*	0.285 *17*	10575.94	(4$^+$)	9516.18	(4)$^+$			
1076.86 *4*	14.84 *31*	9516.18	(4)$^+$	8439.29	4$^+$			I$_\gamma$: Others: 16.0 *15* (1972De28), 13.3 *3* (1979Sh11 – scaled).
1090.67 *10*	0.140 *7*	8439.29	4$^+$	7348.61	2$^+$	[E2]		
^{x}1117[‡]	10.3[‡] *3*							
^{x}1172[‡]	7.3[‡] *2*							
1274.71 *10*	0.106 *6*	10575.94	(4$^+$)	9301.08	(4$^+$)			I$_\gamma$: Contains unknown impurity from ^{22}Na decay.
^{x}1298[‡]	5.2[‡] *2*							
^{x}1340[‡]	7.9[‡] *2*							
1368.625[#] *5*	96.3 *5*	1368.668	2$^+$	0	0$^+$	E2	5.62×10^{-5} *8*	α=5.62×10^{-5} *8*; α(K)=9.29×10^{-6} *13*; α(L)=5.97×10^{-7} *9*; α(M)=2.21×10^{-8} *3* α(IPF)=4.63×10^{-5} *7* E$_\gamma$: Other: 1368.633 *6* (1981Wa07). I$_\gamma$: Weighted average of 96.0 *10* (1979Sh11 – scaled), 96.0 *25* (1979Ho08), and 96.4 *5* (1972De28).
^{x}1434.11 *20*	0.063 *6*							
^{x}1468[‡]	21.2[‡] *4*							
^{x}1633[‡]	3.1[‡] *2*							
1704.8 *8*	0.016 *4*	9516.18	(4)$^+$	7812.0	(4$^-$,5$^+$)			
1771.92 *7*	0.40 *1*	6010.34	4$^+$	4238.35	2$^+$	[E2]	2.11×10^{-4}	α(K)=5.50×10^{-6} *8*; α(L)=3.53×10^{-7} *5*; α(M)=1.310×10^{-8} *19* α(IPF)=0.000205 *3* I$_\gamma$: Other: 0.2 *2* (1979Sh11 – scaled).
1887.52 *20*	0.056 *6*	6010.34	4$^+$	4122.867	4$^+$			I$_\gamma$: component from second transition possibly included.
1899.70 *6*	0.82 *2*	9516.18	(4)$^+$	7616.42	3$^-$	[E1]	5.75×10^{-4}	α(K)=2.89×10^{-6} *4*; α(L)=1.85×10^{-7} *3*; α(M)=6.87×10^{-9} *10* α(IPF)=0.000572 *8* I$_\gamma$: Other: 0.6 *2* (1972De28).
1952.38 *20*	0.094 *6*	9301.08	(4$^+$)	7348.61	2$^+$	[E2]	2.96×10^{-4}	α(K)=4.59×10^{-6} *7*; α(L)=2.95×10^{-7} *5*; α(M)=1.092×10^{-8} *16* α(IPF)=0.000291 *4*
^{x}2127.51 *20*	0.054 *7*							
2136.58 *15*	0.168 *9*	10575.94	(4$^+$)	8439.29	4$^+$			
^{x}2222[‡]	1.5[‡] *1*							

γ(^{24}Mg) (continued)

E_γ[†]	I_γ[†&]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[#]	δ[#]	α[@]	Comments
2381.0 *3*	0.037 *10*	7616.42	3^-	5235.16	3^+	[E1]		8.98×10^{-4}	α(K)=2.10×10^{-6} *3*; α(L)=1.349×10^{-7} *19*; α(M)=5.00×10^{-9} *7* α(IPF)=0.000896 *13*
2428.97 *15*	0.774 *18*	8439.29	4^+	6010.34	4^+				
^{x}2566.96 *20*	0.065 *7*								
2577.4[a] *8*	0.030 *12*	7812.0	$(4^-,5^+)$	5235.16	3^+				
^{x}2630[‡]	4.7[‡] *3*								
2754.030 *14*	40.6 *16*	4122.867	4^+	1368.668	2^+	E2		6.78×10^{-4}	α(K)=2.54×10^{-6} *4*; α(L)=1.632×10^{-7} *23*; α(M)=6.05×10^{-9} *9* α(IPF)=0.000675 *10* I_γ: Unweighted ave. of 41.2 *9* (1981Wa07), 37.6 *6* (1979Sh11 – scaled), 43 *4* (1972De28).
2869.50 *6*	1.10 *4*	4238.35	2^+	1368.668	2^+	M1+E2	−23 *9*	7.30×10^{-4}	α(K)=2.38×10^{-6} *4*; α(L)=1.528×10^{-7} *22*; α(M)=5.67×10^{-9} *8* α(IPF)=0.000727 *11* I_γ: Weighted average of 1.097 *28* (1981Wa07), 1.6 *3* (1979Sh11 – scaled), and 1.4 *4* (1972De28).
3203.88 *8*	3.08 *7*	8439.29	4^+	5235.16	3^+				I_γ: Others: 3.6 *5* (1972De28), 3.9 *3* (1979Sh11 – scaled).
3378.3 *8*	0.043 *7*	7616.42	3^-	4238.35	2^+	[E1]		1.42×10^{-3}	α(K)=1.339×10^{-6} *19*; α(L)=8.59×10^{-8} *12*; α(M)=3.18×10^{-9} *5* α(IPF)=0.001420 *20*
3493.3	0.04 *1*	7616.42	3^-	4122.867	4^+	[E1]		1.47×10^{-3}	α(K)=1.285×10^{-6} *18*; α(L)=8.24×10^{-8} *12*; α(M)=3.06×10^{-9} *5* α(IPF)=0.001473 *21* E_γ: From level energy difference.
3505.61 *9*	1.98 *6*	9516.18	$(4)^+$	6010.34	4^+				I_γ: Others: 1.8 *2* (1979Sh11 – scaled), 2.3 *4* (1972De28).
3866.14 *10*	5.20 *22*	5235.16	3^+	1368.668	2^+	E2(+M1)	−17 *4*	1.12×10^{-3}	α(K)=1.516×10^{-6} *22*; α(L)=9.73×10^{-8} *14*; α(M)=3.61×10^{-9} *5* α(IPF)=0.001122 *16* I_γ: Weighted average 5.26 *22* (1981Wa07), 5.1 *2* (1979Sh11 – scaled), and 5.6 *6* (1972De28).
4200.54 *13*	4.02 *22*	8439.29	4^+	4238.35	2^+	[E2]		1.24×10^{-3}	α(K)=1.347×10^{-6} *19*; α(L)=8.64×10^{-8} *12*; α(M)=3.20×10^{-9} *5* α(IPF)=0.001239 *18* I_γ: Others: 3.1 *2* (1979Sh11 – scaled), 4.4 *5* (1972De28).
4237.96 *6*	3.61 *21*	4238.35	2^+	0	0^+	[E2]		1.25×10^{-3}	α(K)=1.330×10^{-6} *19*; α(L)=8.53×10^{-8} *12*; α(M)=3.16×10^{-9} *5* α(IPF)=0.001253 *18* I_γ: Other: 2.6 *3* (1979Sh11 – scaled), 3.6 *4* (1972De28).
4280.62 *13*	0.66 *4*	9516.18	$(4)^+$	5235.16	3^+				I_γ: Other: 0.30 *15* (1972De28).
4316.00 *12*	13.3 *6*	8439.29	4^+	4122.867	4^+				I_γ: Weighted average of 14.2 *9* (1981Wa07), 12.7 *6* (1979Sh11 – scaled), and 15.0 *15* (1972De28).
4641.19 *9*	3.42 *25*	6010.34	4^+	1368.668	2^+	[E2]		1.38×10^{-3}	α(K)=1.172×10^{-6} *17*; α(L)=7.52×10^{-8} *11*; α(M)=2.79×10^{-9} *4* α(IPF)=0.001381 *20* I_γ: Other: 2.3 *2* (1979Sh11 – scaled), 3.6 *7* (1972De28).
5060.7 *8*	0.036 *13*	9301.08	(4^+)	4238.35	2^+	[E2]		1.51×10^{-3}	α(K)=1.041×10^{-6} *15*; α(L)=6.68×10^{-8} *10*; α(M)=2.48×10^{-9} *4* α(IPF)=0.001504 *21*
5177.51 *20*	0.98 *10*	9301.08	(4^+)	4122.867	4^+				I_γ: Other: 1.0 *2* (1972De28).
5340.3 *4*	0.115 *13*	10575.94	(4^+)	5235.16	3^+				
5392.68 *9*	17.3 *19*	9516.18	$(4)^+$	4122.867	4^+				I_γ: Unweighted ave. of 18.3 *18* (191Wa07), 13.5 *9* (1979Sh11 – scaled), 20 *2* (1972De28).

From ENSDF

$\gamma(^{24}Mg)$ (continued)

E_γ [†]	I_γ [†&]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [#]	Comments
5979.5 *8*	0.093 *9*	7348.61	2^+	1368.668	2^+		
[x]6128[‡]	1.8[‡] *2*						
6246.89 *11*	0.54 *4*	7616.42	3^-	1368.668	2^+		I_γ: Other: 0.7 *1* (1972De28).
7069.50 *12*	43.2 *13*	8439.29	4^+	1368.668	2^+	[E2]	I_γ: Weighted average of 43.0 *13* (1981Wa07), 47.5 *40* (1979Sh11 − scaled), and 41 *4* (1972De28).
7348.2 *9*	0.153 *16*	7348.61	2^+	0	0^+	[E2]	
7615.2 *9*	0.224 *15*	7616.42	3^-	0	0^+		
[x]7648[‡]	0.9[‡] *2*						
[x]7850[‡]	0.8[‡] *2*						
7930.87 *15*	1.29 *10*	9301.08	(4^+)	1368.668	2^+	[E2]	I_γ: Weighted average of 1.34 *10* (1981Wa07), 1.0 *2* (1979Sh11 − scaled), and 1.4 *2* (1972De28).
8087.7	0.020 *10*	9457.81	$(3)^+$	1368.668	2^+		E_γ: From level energy difference. 8085.66 in 1981Wa07.
8146.0	0.028 *7*	9516.18	$(4)^+$	1368.668	2^+	[E2]	E_γ: From level energy difference.
9450.1 *4*	0.110 *20*	10820.8	$3^+,4^+$	1368.668	2^+		E_γ,I_γ: Other: 9440 *10* in parentheses − probably to indicate uncertain (1972De28) and 0.10 *5*, respectively.
9943.5 *15*	0.027 *6*	11314.4	$(3,4)^+$	1368.668	2^+		
[x]9962[‡]	0.37[‡] *10*						E_γ: Placement from an 1 to 0 spin states, no excitation energy is mentioned (1979Sh11).

[†] From 1981Wa07, except where otherwise noted. $I\gamma$ reported in 1979Sh11 is scaled to $I\gamma(1368\gamma)$=96 (1981Wa07).
[‡] From 1979Sh11, scaled to $I\gamma(1368\gamma)$=96 (1981Wa07).
[#] From Adopted Gammas.
[@] Additional information 1.
[&] Absolute intensity per 100 decays.
[a] Placement of transition in the level scheme is uncertain.
[x] γ ray not placed in level scheme.

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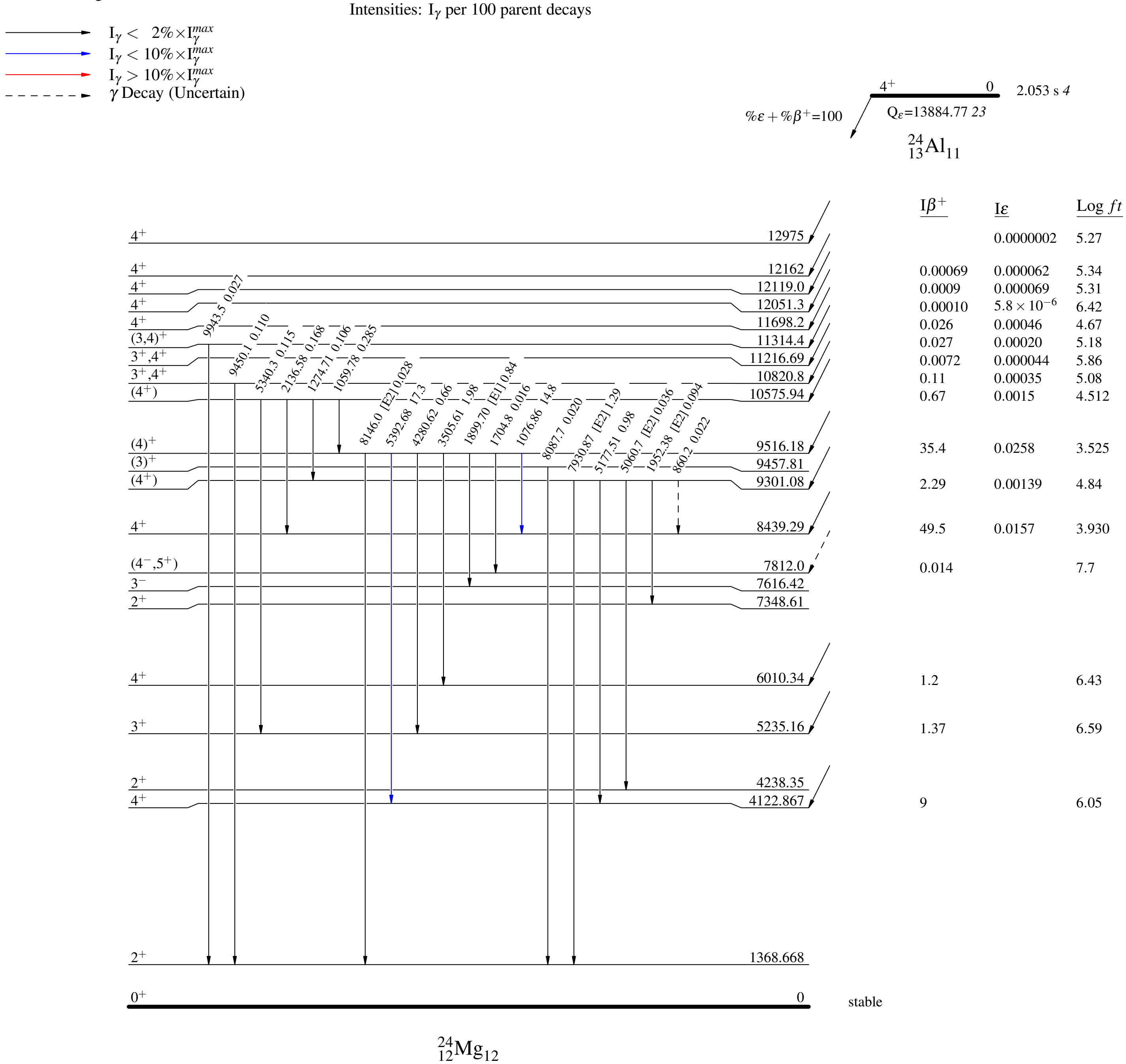
Decay Scheme

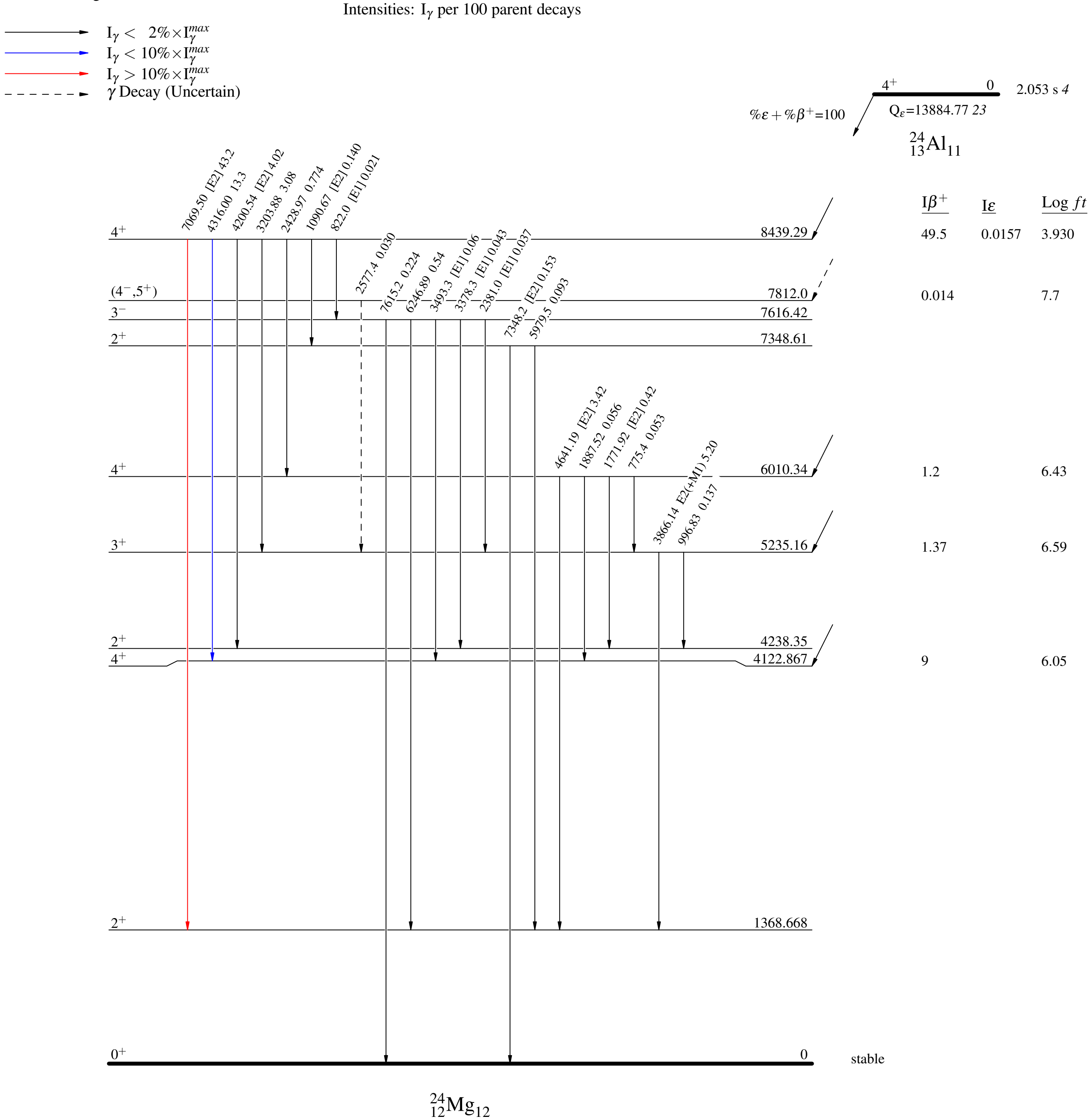
Intensities: I_γ per 100 parent decays



^{24}Al ε decay (2.053 s) 1981Wa07,1979Ho08

Decay Scheme (continued)

Intensities: I_γ per 100 parent decays



^{24}Al ε decay (2.053 s) 1981Wa07,1979Ho08

Decay Scheme (continued)

Intensities: I_γ per 100 parent decays