^{77}Zn β^- decay (2.08 s) 1986Ek01

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh	ENSDF	30-Sep-2020

Parent: ^{77}Zn: E=0.0; $J^\pi=7/2^+$; $T_{1/2}$=2.08 s *5*; Q(β^-)=7203 *3*; %β^- decay=100.0

^{77}Zn-J^π,$T_{1/2}$: From ^{77}Zn Adopted Levels.

^{77}Zn-Q(β^-): from 2017Wa10. Measured mass excess for ^{77}Ga=−65995.0 keV *42* (2019Hu15), as compared to −65992.3 keV *24* in 2017Wa10 leads to Q(β^-)=7205.8 keV *47*.

1986Ek01 (also 1981Ru07, 1977Al17): measured Eγ, Iγ, $\gamma\gamma$, $\gamma\gamma$(t), $\beta\gamma$.

^{77}Zn isotope produced as a fission fragment.

Additional information 1.

Total decay energy of 7487 keV *233* deduced (by RADLIST code) from proposed decay scheme is in agreement with the expected value of 7203 keV *3*, indicating that decay scheme is fairly complete.

^{77}Ga Levels

E(level)[†]	J^π[#]	$T_{1/2}$[‡#]	E(level)[†]	J^π[#]	$T_{1/2}$[‡#]
0.0	$3/2^{(-)}$	13.2 s *2*	2028.29 *5*		
105.66 *4*	$(1/2^-)$	<4 ns	2028.81 *7*	$(9/2^+)$	4.4 ns *8*
160.95 *3*	$(3/2^-)$	<2 ns	2138.04 *4*	$(^+)$	
189.49 *3*	$(5/2^-)$	<2 ns	2149.31 *6*		
474.059 *25*	$(5/2^-)$		2327.5 *8*		
626.41 *3*	$(7/2^-)$		2348.53 *5*		
873.36 *3*	$(7/2^-)$		2357.17 *5*		
1116.34 *4*	$(9/2^-)$		2385.01 *6*		
1233.96 *5*	$(3/2^-,5/2^-)$		2425.68 *5*		
1282.32 *5*	$(7/2^-,9/2^-)$		2698.77 *5*	$(^+)$	
1403.19 *8*			2805.74 *6*	$(^+)$	
1477.33 *6*	$(11/2^-)$		2828.60 *21*		
1515.88 *6*			2861.8 *3*		
1797.11 *21*			3242.97 *12*		
1831.99 *4*	$(^+)$		3267.63 *5*	$(^+)$	
1857.85 *6*			3529.92 *16*		
1872.56 *4*			3945.89 *21*		
1970.03 *4*	$(11/2^-)$				

[†] From least-squares fit to Eγ data. Reduced χ^2=2.2. Uncertainties of five γ-ray energies were increased by a factor of 2 or 3 to get an acceptable fit.

[‡] From $\gamma\gamma$(t) for excited states (1986Ek01).

[#] From Adopted Levels. For levels above 200, log *ft* values restrict J to 5/2, 7/2 or 9/2, assuming $7/2^+$ for ^{77}Zn g.s. J=9/2 is not likely for levels that decay to g.s. of $J^\pi=3/2^{(-)}$.

β^- radiations

E(decay)	E(level)	Iβ^-[†‡]	Log *ft*	Comments
(3257 *3*)	3945.89	0.20 *6*	6.2 *1*	av Eβ=1403.6 *15*
(3673 *3*)	3529.92	1.24 *13*	5.66 *5*	av Eβ=1603.3 *15*
(3935 *3*)	3267.63	4.8 *10*	5.2 *1*	av Eβ=1729.7 *15*
				E(decay): 3930 *920* from β(3268γ) coin.
(3960 *3*)	3242.97	0.79 *9*	6.00 *5*	av Eβ=1741.6 *15*
(4341 *3*)	2861.8	0.22 *3*	6.7 *1*	av Eβ=1925.7 *15*
(4374 *3*)	2828.60	0.39 *9*	6.5 *1*	av Eβ=1941.8 *15*
(4397 *3*)	2805.74	6.5 *9*	5.3 *1*	av Eβ=1952.9 *15*

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^{77}Zn β^- decay (2.08 s) 1986Ek01 (continued)

β^- radiations (continued)

E(decay)	E(level)	Iβ^-[†][‡]	Log *ft*	Comments
				E(decay): 4490 *230* from β(836γ) coin.
(4504 *3*)	2698.77	8.9 *13*	5.2 *1*	av Eβ=2004.6 *15*
				E(decay): 4560 *170* from β(561γ) coin and β(670γ) coin.
(4777 *3*)	2425.68	0.53 *17*	6.5 *2*	av Eβ=2136.9 *15*
(4818 *3*)	2385.01	2.64 *21*	5.86 *4*	av Eβ=2156.6 *15*
(4846 *3*)	2357.17	2.92 *21*	5.82 *4*	av Eβ=2170.1 *15*
(4854 *3*)	2348.53	3.4 *4*	5.8 *1*	av Eβ=2174.3 *15*
(4876 *3*)	2327.5	0.59 *9*	6.5 *1*	av Eβ=2184.5 *16*
(5054 *3*)	2149.31	1.46 *19*	6.2 *2*	av Eβ=2270.9 *15*
(5065 *3*)	2138.04	12.2 *14*	5.29 *5*	av Eβ=2276.4 *15*
(5174 *3*)	2028.81	2.8 *9*	6.0 *2*	av Eβ=2329.4 *15*
(5175 *3*)	2028.29	5.3 *10*	5.7 *1*	av Eβ=2329.6 *15*
(5233[#] *3*)	1970.03	1.4 *11*	8.1^{1u} *4*	av Eβ=2359.2 *15*
(5330 *3*)	1872.56	2.22 *23*	6.13 *5*	av Eβ=2405.2 *15*
(5345 *3*)	1857.85	1.8 *3*	6.2 *1*	av Eβ=2412.3 *15*
(5371 *3*)	1831.99	9.5 *13*	5.5 *2*	av Eβ=2424.9 *15*
(5406 *3*)	1797.11	0.96 *10*	6.52 *5*	av Eβ=2441.8 *15*
(5687 *3*)	1515.88	1.32 *11*	6.48 *4*	av Eβ=2578.4 *15*
(5726[#] *3*)	1477.33	<0.7	>8.7^{1u}	av Eβ=2597.8 *15*
(5800 *3*)	1403.19	1.69 *22*	6.4 *1*	av Eβ=2633.2 *15*
(5921 *3*)	1282.32	1.9 *11*	6.4 *3*	av Eβ=2691.9 *15*
(5969 *3*)	1233.96	1.7 *3*	6.5 *1*	av Eβ=2715.4 *15*
(6087 *3*)	1116.34	2.3 *13*	6.4 *3*	av Eβ=2772.6 *15*
(6330 *3*)	873.36	1.8 *12*	6.6 *3*	av Eβ=2890.7 *15*
(6577 *3*)	626.41	8.1 *10*	6.0 *1*	av Eβ=3010.8 *15*
(6729[#] *3*)	474.059	<3	>6.5	av Eβ=3084.9 *15*
(7014 *3*)	189.49	6.2 *15*	6.2 *1*	av Eβ=3223.2 *15*
(7042 *3*)	160.95	2.3 *15*	8.8^{1u} *3*	av Eβ=3237.6 *16*
(7203[#] *3*)	0.0	<5	>8.5^{1u}	av Eβ=3315.9 *15*
				Iβ^-: from log $f^{1u}t$>8.5.

[†] From γ-ray intensity balance at each level, unless otherwise stated.
[‡] Absolute intensity per 100 decays.
[#] Existence of this branch is questionable.

γ(^{77}Ga)

Iγ normalization: From I(γ+ce)(gammas to g.s.)=97.5% *25* based on I(β- to g.s.) <5% corresponding to log $f^{1u}t$>8.5.

E$_\gamma$	I$_\gamma$[a]	E$_i$(level)	J$_i^\pi$	E$_f$	J$_f^\pi$	Mult.[†]	α[b]	Comments
55.1 *2*	7.0 *3*	160.95	(3/2$^-$)	105.66	(1/2$^-$)	(M1)	0.364 *7*	α(K)=0.324 *6*; α(L)=0.0348 *6*; α(M)=0.00510 *9*; α(N)=0.000268 *5*
105.66 *5*	28 *5*	105.66	(1/2$^-$)	0.0	3/2$^{(-)}$	(M1)	0.0602	α(K)=0.0536 *8*; α(L)=0.00568 *8*; α(M)=0.000830 *12*; α(N)=4.41×10^{-5} *7*
152.43 *6*	15.0 *13*	626.41	(7/2$^-$)	474.059	(5/2$^-$)	[D,E2]	0.08 *6*	
160.93 *5*	30 *3*	160.95	(3/2$^-$)	0.0	3/2$^{(-)}$	[M1,E2]	0.07 *5*	α(K)=0.06 *5*; α(L)=0.007 *5*; α(M)=0.0010 *8*; α(N)=5.E−5 *4*
168.09 *5*	1.3 *3*	2138.04	(+)	1970.03	(11/2$^-$)			
189.49 *4*	100 *4*	189.49	(5/2$^-$)	0.0	3/2$^{(-)}$	(M1)	0.01298	α(K)=0.01159 *17*; α(L)=0.001206 *17*; α(M)=0.0001766 *25*; α(N)=9.45×10^{-6} *14*

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^{77}Zn β^- decay (2.08 s) 1986Ek01 (continued)

$\gamma(^{77}Ga)$ (continued)

E_γ	I_γ[a]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[†]	Comments
195.0 *2*	1.2 *3*	1477.33	(11/2$^-$)	1282.32	(7/2$^-$,9/2$^-$)		
196.8[#] *2*	1.2 *3*	2028.29		1831.99	($^+$)		E_γ: level-energy difference=196.3.
219.07 *5*	4.2 *4*	2357.17		2138.04	($^+$)		
235.68 *5*	1.5 *3*	2385.01		2149.31			
246.90 *5*	3.2 *5*	873.36	(7/2$^-$)	626.41	(7/2$^-$)		
284.56 *5*	6.3 *6*	474.059	(5/2$^-$)	189.49	(5/2$^-$)		
291.42 *5*	4.8 *5*	2149.31		1857.85			
305.94 *5*	21 *2*	2138.04	($^+$)	1831.99	($^+$)		
313.12 *6*	8.4 *6*	474.059	(5/2$^-$)	160.95	(3/2$^-$)		
357.5 *8*	2.1 *3*	2327.5		1970.03	(11/2$^-$)		
361.1 *2*	2.5 *3*	1477.33	(11/2$^-$)	1116.34	(9/2$^-$)		
368.44 *5*	14.4 *5*	474.059	(5/2$^-$)	105.66	(1/2$^-$)		
378.48 *5*	2.8 *3*	2348.53		1970.03	(11/2$^-$)		
387.0 *1*	1.1 *3*	2357.17		1970.03	(11/2$^-$)		
399.16[#] *5*	18 *2*	873.36	(7/2$^-$)	474.059	(5/2$^-$)		E_γ: level-energy difference=399.30.
408.5[‡c] *2*	2.0 *2*	1282.32	(7/2$^-$,9/2$^-$)	873.36	(7/2$^-$)		
436.80 *8*	11.6 *9*	626.41	(7/2$^-$)	189.49	(5/2$^-$)		
[x]441.10 *7*	2.7 *3*						
465.5 *2*	13 *1*	626.41	(7/2$^-$)	160.95	(3/2$^-$)		
473.94 *5*	70 *7*	474.059	(5/2$^-$)	0.0	3/2$^{(-)}$		
489.7 *2*	1.0 *5*	1116.34	(9/2$^-$)	626.41	(7/2$^-$)		
516.57 *6*	12 *1*	2348.53		1831.99	($^+$)		
551.47 *5*	14.5 *7*	2028.81	(9/2$^+$)	1477.33	(11/2$^-$)		
560.74 *5*	13.6 *6*	2698.77	($^+$)	2138.04	($^+$)		
597.8 *3*	7.1 *7*	1831.99	($^+$)	1233.96	(3/2$^-$,5/2$^-$)		
626.40 *5*	20 *2*	626.41	(7/2$^-$)	0.0	3/2$^{(-)}$		
667.7 *1*	6 *2*	2805.74	($^+$)	2138.04	($^+$)		
669.95 *10*	9 *3*	2698.77	($^+$)	2028.81	(9/2$^+$)		
670.46 *10*	9 *3*	2698.77	($^+$)	2028.29			
684.0 *1*	6.6 *4*	873.36	(7/2$^-$)	189.49	(5/2$^-$)		
688.0[#] *1*	1.5 *7*	1970.03	(11/2$^-$)	1282.32	(7/2$^-$,9/2$^-$)		E_γ: level-energy difference=687.7.
712.41 *5*	2.5 *4*	873.36	(7/2$^-$)	160.95	(3/2$^-$)		
746.6 *4*	1.2 *3*	2028.81	(9/2$^+$)	1282.32	(7/2$^-$,9/2$^-$)		
756.17 *5*	3.1 *6*	1872.56		1116.34	(9/2$^-$)		
759.82 *6*	2.1 *3*	1233.96	(3/2$^-$,5/2$^-$)	474.059	(5/2$^-$)		
800.3 *2*	1.4 *3*	2828.60		2028.29			
808.29 *5*	14 *2*	1282.32	(7/2$^-$,9/2$^-$)	474.059	(5/2$^-$)		
835.70 *5*	17 *2*	2805.74	($^+$)	1970.03	(11/2$^-$)		
842.00 *9*	4.1 *4*	3267.63	($^+$)	2425.68			
850.89 *7*	12 *1*	1477.33	(11/2$^-$)	626.41	(7/2$^-$)		
853.70 *6*	10 *3*	1970.03	(11/2$^-$)	1116.34	(9/2$^-$)		
855.7 *6*	8 *3*	2138.04	($^+$)	1282.32	(7/2$^-$,9/2$^-$)		
873.44 *5*	25 *3*	873.36	(7/2$^-$)	0.0	3/2$^{(-)}$		
912.0 *10*	3.3 *7*	2028.81	(9/2$^+$)	1116.34	(9/2$^-$)		
919.0 *10*	2.8 *6*	3267.63	($^+$)	2348.53			
926.84 *5*	27 *3*	1116.34	(9/2$^-$)	189.49	(5/2$^-$)		
999.22 *4*	4.8 *4*	1872.56		873.36	(7/2$^-$)		
1021.6 *5*	0.5 *2*	2138.04	($^+$)	1116.34	(9/2$^-$)		
1041.81 *5*	3.8 *3*	1515.88		474.059	(5/2$^-$)		
1093.1[#] *1*	3.5 *3*	1282.32	(7/2$^-$,9/2$^-$)	189.49	(5/2$^-$)		E_γ: level-energy difference=1092.8.
1096.61 *5*	16 *1*	1970.03	(11/2$^-$)	873.36	(7/2$^-$)		
1116.6 *3*	0.7 *1*	1116.34	(9/2$^-$)	0.0	3/2$^{(-)}$	[M3]	
1128.34 *9*	2.3 *3*	1233.96	(3/2$^-$,5/2$^-$)	105.66	(1/2$^-$)		
1154.86 *5*	6.9 *4*	2028.29		873.36	(7/2$^-$)		
1234.1 *1*	8.6 *5*	1233.96	(3/2$^-$,5/2$^-$)	0.0	3/2$^{(-)}$		

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^{77}Zn β^- decay (2.08 s) 1986Ek01 (continued)

$\gamma(^{77}Ga)$ (continued)

E_γ	I_γ[a]	E_i(level)	J_i^π	E_f	J_f^π	Comments
1242.1 *1*	1.0 *5*	1403.19		160.95	$(3/2^-)$	
1264.60 *5*	15 *1*	2138.04	$(^+)$	873.36	$(7/2^-)$	
1269.0 *2*	1.1 *2*	2385.01		1116.34	$(9/2^-)$	
1326.8 *4*	0.9 *1*	1515.88		189.49	$(5/2^-)$	
1343.9 *5*	3.1 *3*	1970.03	$(11/2^-)$	626.41	$(7/2^-)$	
1357.90 *5*	19.0 *15*	1831.99	$(^+)$	474.059	$(5/2^-)$	
1385.1 *1*	2.8 *3*	3242.97		1857.85		
1401.5 *6*	2.7 *3*	2028.29		626.41	$(7/2^-)$	
1403.3 *1*	5.0 *5*	1403.19		0.0	$3/2^{(-)}$	
1436.0& *1*	2.1 *3*	3267.63	$(^+)$	1831.99	$(^+)$	
1483.96# *7*	5.1 *3*	2357.17		873.36	$(7/2^-)$	E_γ: level-energy difference=1483.79.
1511.73 *7*	6.3 *6*	2138.04	$(^+)$	626.41	$(7/2^-)$	
1554.55#@ *7*	4.0 *6*	2028.29		474.059	$(5/2^-)$	E_γ: level-energy difference=1554.22.
1560.4 *4*	1.2 *2*	3529.92		1970.03	$(11/2^-)$	
1607.6 *2*	3.4 *3*	1797.11		189.49	$(5/2^-)$	
[x]1641.9 *9*	2.5 *3*					
1663.93 *7*	15 *1*	2138.04	$(^+)$	474.059	$(5/2^-)$	
1751.60#& *7*	8.9 *7*	1857.85		105.66	$(1/2^-)$	E_γ: level-energy difference=1752.18.
1758.8 *2*	3.8 *4*	2385.01		626.41	$(7/2^-)$	
1832.0 *2*	44 *3*	1831.99	$(^+)$	0.0	$3/2^{(-)}$	
1838.75 *8*	14.3 *5*	2028.29		189.49	$(5/2^-)$	
1857.82 *7*	5.0 *5*	1857.85		0.0	$3/2^{(-)}$	
1988.7& *1*	1.9 *2*	2149.31		160.95	$(3/2^-)$	
2195.43 *8*	3.0 *3*	2385.01		189.49	$(5/2^-)$	
2264.74 *7*	3.0 *3*	2425.68		160.95	$(3/2^-)$	
2425.64 *7*	3.0 *3*	2425.68		0.0	$3/2^{(-)}$	
[x]2545.5 *2*	1.6 *2*					
2672.3 *3*	0.8 *1*	2861.8		189.49	$(5/2^-)$	
2793.6 *1*	2.0 *3*	3267.63	$(^+)$	474.059	$(5/2^-)$	
[x]2960.0 *2*	1.5 *2*					
3056.3 *3*	2.1 *2*	3529.92		474.059	$(5/2^-)$	
3106.4‡[c] *1*	6.3 *6*	3267.63	$(^+)$	160.95	$(3/2^-)$	
3267.5 *1*	2.5 *3*	3267.63	$(^+)$	0.0	$3/2^{(-)}$	
3340.0 *2*	1.1 *3*	3529.92		189.49	$(5/2^-)$	
[x]3380.0 *1*	1.8 *3*					
3756.3 *2*	0.7 *2*	3945.89		189.49	$(5/2^-)$	

[†] From ce data. However, details of such data are not available. When internal conversion is expected to be significant and no ΔJ^π information is available, multipolarity is assumed as D,E2, based on general occurrence of such transitions.
[‡] Placement suggested by the evaluators on the basis of $\gamma\gamma$ (1986Ek01).
[#] Somewhat poor fit in the level scheme.
[@] For least-squares fit, uncertainty increased by a factor of 2.
[&] For least-squares fit, uncertainty increased by a factor of 3.
[a] For absolute intensity per 100 decays, multiply by 0.281 *12*.
[b] Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.
[c] Placement of transition in the level scheme is uncertain.
[x] γ ray not placed in level scheme.

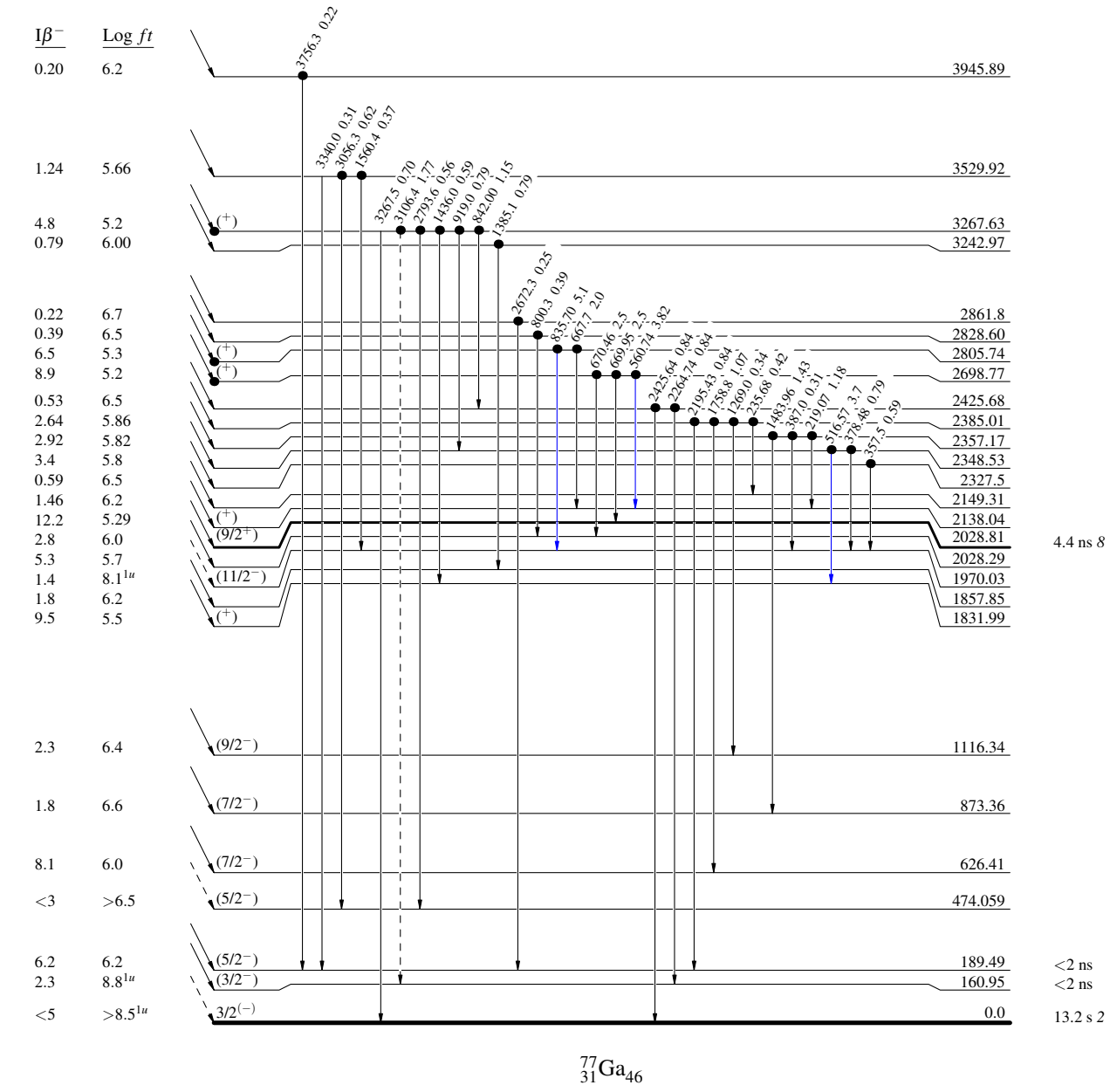
^{77}Zn β^- decay (2.08 s) 1986Ek01

Decay Scheme

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

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

$7/2^+$ 0.0 2.08 s *5*
Q_{β^-}=7203 *3* %β^-=100
$^{77}_{30}Zn_{47}$

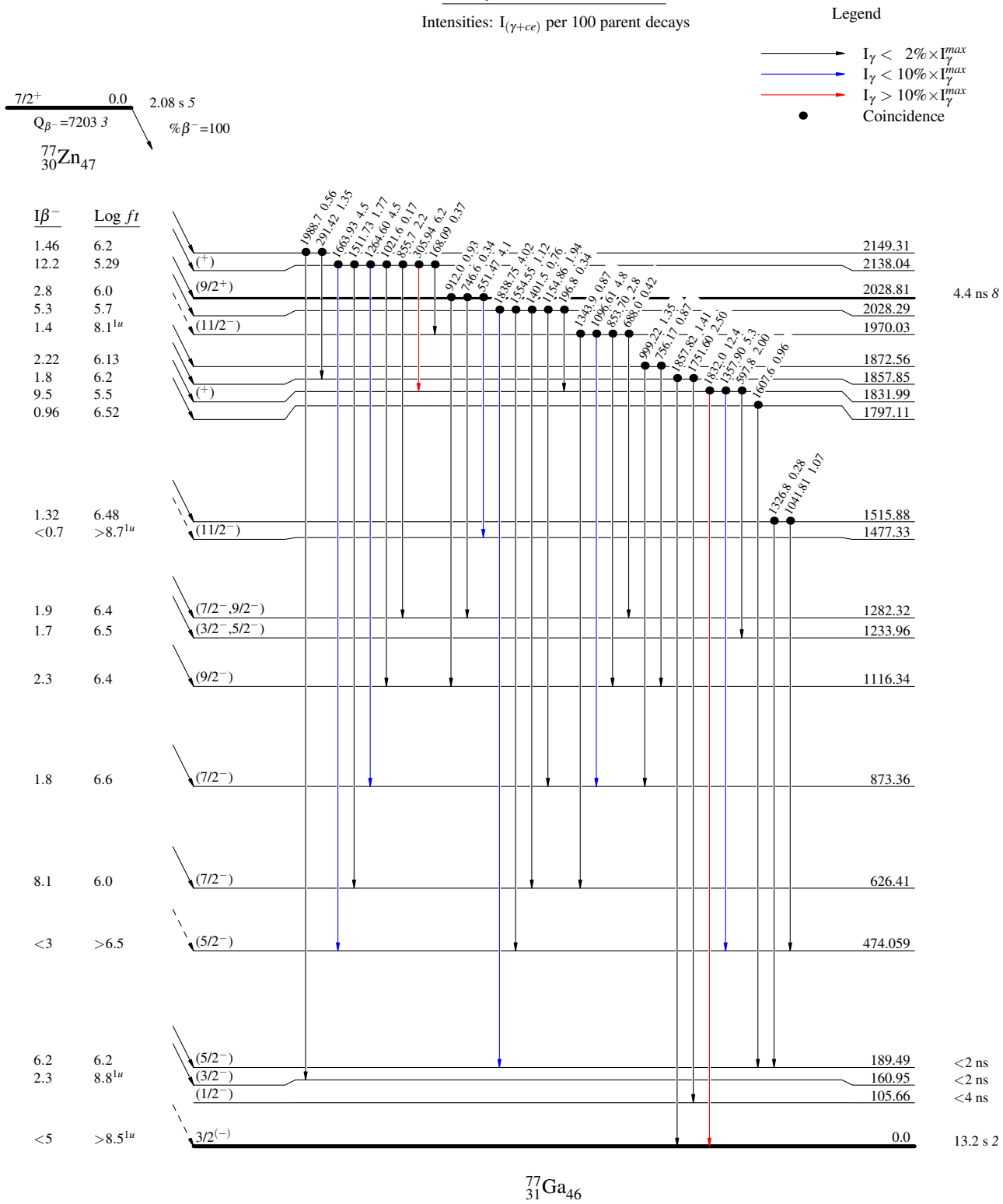


$^{77}_{31}Ga_{46}$

^{77}Zn β^- decay (2.08 s) 1986Ek01

Decay Scheme (continued)

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



^{77}Zn β^- decay (2.08 s) 1986Ek01

Decay Scheme (continued)

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

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

7/2+ 0.0 2.08 s 5
Q_{β^-}=7203 3 $\%\beta^-$=100
$^{77}_{30}Zn_{47}$

Iβ⁻	Log ft			
<0.7	>8.7[1u]	(11/2⁻)	1477.33	
1.69	6.4		1403.19	
1.9	6.4	(7/2⁻,9/2⁻)	1282.32	
1.7	6.5	(3/2⁻,5/2⁻)	1233.96	
2.3	6.4	(9/2⁻)	1116.34	
1.8	6.6	(7/2⁻)	873.36	
8.1	6.0	(7/2⁻)	626.41	
<3	>6.5	(5/2⁻)	474.059	
6.2	6.2	(5/2⁻)	189.49	<2 ns
2.3	8.8[1u]	(3/2⁻)	160.95	<2 ns
		(1/2⁻)	105.66	<4 ns
<5	>8.5[1u]	3/2(⁻)	0.0	13.2 s 2

$^{77}_{31}Ga_{46}$