^{61}Zn ε decay (89.1 s) 1970Ho29,1972Du09

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Kazimierz Zuber, Balraj Singh	NDS 125, 1 (2015)	25-Jan-2015

Parent: ^{61}Zn: E=0; J$^\pi$=3/2$^-$; T$_{1/2}$=89.1 s *2*; Q(ε)=5635 *16*; %ε+%β^+ decay=100.0
^{61}Zn-J$^\pi$,T$_{1/2}$: From Adopted Levels for ^{61}Zn.
^{61}Zn-Q(ε): From 2012Wa38.
Source produced by ^{58}Ni(α,n) (1970Ho29,1969Ho02).
1970Ho29: measured Eγ, Iγ, γ(t) with Compton suppression spectrometer.
1972Du09: measured Eγ, Iγ, γ(t) with Ge(Li). Mass separated source.
Others: 1955Li39, 1959Cu86, 1969Ho02, 1974YoZT.
The decay scheme is based on $\gamma\gamma$ coin data from 1969Ho02 and on energy sums.
Data are from 1970Ho29, except as noted. There is good agreement between the results of 1970Ho29 and 1972Du09.
From RADLIST code, deduced total decay energy is 5638 keV *70* agrees with 5640 keV *16* from Q(ε) value.

^{61}Cu Levels

E(level)†	J$^\pi$‡	E(level)†	J$^\pi$‡	E(level)†	J$^\pi$‡	E(level)†	J$^\pi$‡
0.0	3/2$^-$	1660.44 *7*	3/2$^-$	2358.13 *11*	3/2$^-$	2857.1 *3*	1/2$^-$,3/2$^-$
474.98 *7*	1/2$^-$	1732.4 *12*	7/2$^-$	2472.50 *13*	3/2$^-$	2932.91 *16*	3/2$^-$
970.10 *11*	5/2$^-$	1904.5 *3*	5/2$^-$	2683.96 *20*	3/2$^-$	3019.3 *11*	3/2$^-$
1310.94 *10*	7/2$^-$	1932.60 *8*	3/2$^-$	2792.98 *13*	5/2$^-$	3092.4 *13*	3/2$^-$
1394.52 *8*	5/2$^-$	2088.86 *9*	(1/2)$^-$	2840.53 *14*	1/2$^-$,3/2$^-$	3521.2 *15*	1/2$^-$,3/2$^-$,5/2$^-$

† From least-squares fit to Eγ data.
‡ From Adopted Levels.

ε,β^+ radiations

Measured endpoint energy of β^+ radiation is 4380 *200*. This β^+ endpoint must correspond to g.s. feeding from intensity arguments (1959Cu86).

E(decay)	E(level)	Iβ^+ ‡#	Iε‡#	Log *ft*	I($\varepsilon+\beta^+$)†#	Comments
(2114 *16*)	3521.2	0.09 *3*	0.047 *14*	5.5 *2*	0.14 *4*	av Eβ=469.9 *71*; εK=0.300 *10*; εL=0.0329 *11*; εM+=0.00574 *19*
(2543 *16*)	3092.4	0.098 *20*	0.017 *4*	6.1 *1*	0.115 *24*	av Eβ=662.0 *73*; εK=0.134 *4*; εL=0.0146 *5*; εM+=0.00255 *8*
(2616 *16*)	3019.3	0.23 *3*	0.035 *4*	5.80 *6*	0.26 *3*	av Eβ=695.2 *73*; εK=0.118 *4*; εL=0.0129 *4*; εM+=0.00225 *7*
(2702 *16*)	2932.91	0.73 *6*	0.094 *8*	5.39 *4*	0.82 *7*	av Eβ=734.6 *74*; εK=0.102 *3*; εL=0.0112 *3*; εM+=0.00195 *6*
(2778 *16*)	2857.1	0.48 *6*	0.054 *7*	5.66 *6*	0.53 *7*	av Eβ=769.3 *74*; εK=0.0903 *24*; εL=0.0099 *3*; εM+=0.00172 *5*
(2794 *16*)	2840.53	0.50 *5*	0.055 *5*	5.66 *5*	0.55 *5*	av Eβ=776.9 *74*; εK=0.0880 *23*; εL=0.00961 *25*; εM+=0.00168 *5*
(2842 *16*)	2792.98	1.58 *14*	0.160 *14*	5.21 *4*	1.74 *15*	av Eβ=798.7 *74*; εK=0.0817 *21*; εL=0.00892 *23*; εM+=0.00156 *4*
(2951 *16*)	2683.96	1.37 *9*	0.116 *8*	5.38 *4*	1.49 *10*	av Eβ=848.9 *74*; εK=0.0693 *17*; εL=0.00756 *19*; εM+=0.00132 *4*
(3163 *16*)	2472.50	1.29 *8*	0.079 *6*	5.60 *4*	1.37 *9*	av Eβ=946.9 *75*; εK=0.0514 *12*; εL=0.00561 *13*; εM+=0.000980 *22*
(3277 *16*)	2358.13	1.29 *9*	0.068 *5*	5.70 *4*	1.36 *9*	av Eβ=1000.2 *75*; εK=0.0442 *10*; εL=0.00483 *10*; εM+=0.000843 *18*

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^{61}Zn ε decay (89.1 s) 1970Ho29,1972Du09 (continued)

ε,β^+ radiations (continued)

E(decay)	E(level)	Iβ$^+$ [‡#]	Iε[‡#]	Log *ft*	I(ε+β$^+$)[†#]	Comments
(3546 16)	2088.86	0.58 6	0.022 2	6.27 5	0.60 6	av Eβ=1126.3 76; εK=0.0318 6; εL=0.00347 7; εM+=0.000606 12
(3702 16)	1932.60	0.79 11	0.024 3	6.25 6	0.81 11	av Eβ=1199.9 76; εK=0.0267 5; εL=0.00291 6; εM+=0.000509 9
(3731 16)	1904.5	0.23 6	0.0070 18	6.8 1	0.24 6	av Eβ=1213.1 76; εK=0.0259 5; εL=0.00283 5; εM+=0.000493 9
(3903[@] 16)	1732.4	<0.16	<0.0027	>7.5	<0.16	av Eβ=1294.5 76; εK=0.0216 4; εL=0.00236 4; εM+=0.000411 7 No β feeding is expected to this level, small apparent feeding of <0.11% 5 is probably due to missing γ rays from higher levels.
(3975 16)	1660.44	10.8 7	0.252 17	5.30 3	11.1 7	av Eβ=1328.7 76; εK=0.0201 4; εL=0.00219 4; εM+=0.000383 7
(4240 16)	1394.52	0.66 6	0.012 1	6.69 4	0.67 6	av Eβ=1455.2 77; εK=0.01559 23; εL=0.00170 3; εM+=0.000297 5
(4324[@] 16)	1310.94	<0.098	<0.002	>7.6	<0.10	av Eβ=1495.0 77; εK=0.01446 21; εL=0.001576 23; εM+=0.000275 4 No β feeding is expected to this level, small apparent feeding of <0.10% is probably due to missing γ rays from higher levels.
(4665 16)	970.10	0.46 19	0.0057 23	7.1 2	0.47 19	av Eβ=1658.2 77; εK=0.01082 15; εL=0.001179 16; εM+=0.000206 3
(5160 16)	474.98	10.8 6	0.091 5	5.97 3	10.9 6	av Eβ=1896.6 78; εK=0.00743 9; εL=0.000809 10; εM+=0.0001413 1
(5635 16)	0.0	66.3 17	0.405 12	5.40 2	66.7 17	av Eβ=2126.5 78; εK=0.00539 6; εL=0.000587 6; εM+=0.0001025 1

† From intensity imbalance at each level.
‡ From I(γ+ce) and theoretical β^+/ε.
\# Absolute intensity per 100 decays.
@ Existence of this branch is questionable.

γ(^{61}Cu)

Iγ normalization: Measured annihilation radiation intensity is 2600 130 (1969Ho02) relative to 100 for 1660γ. From theoretical β^+/ε ratios for g.s. and some of the intensely populated levels, intensity of electron capture fraction is estimated as 5.0 relative units, thus the total I(β^++ε)=1305 65 units which gives normalization factor of 0.0766 38 for 100 decays.
The 1234.0γ and 1289.8γ seen by 1970Ho29 were not observed by 1972Du09 (Iγ≤0.6).

Eγ	Iγ[†@]	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	Mult.[‡]	δ[‡]	Comments
[x]149.0 3	2.2 9							
265.9 1	7.0 4	1660.44	3/2$^-$	1394.52	5/2$^-$			
421[#] 2	<1.2[#]	1732.4	7/2$^-$	1310.94	7/2$^-$	M1(+E2)	+0.08 7	
426.0 4	1.9 1	2358.13	3/2$^-$	1932.60	3/2$^-$			
475.0 1	216 3	474.98	1/2$^-$	0.0	3/2$^-$	M1+E2	0.04	δ: theoretical estimate by 1972Ca20 adopted by 1973Sa19 in (α,pγ).
594.2[#] 15	0.8[#] 5	1904.5	5/2$^-$	1310.94	7/2$^-$	M1+E2	−0.05 3	
[x]604.5[#] 10	<1.1[#]							
[x]638.2[#] 5	<1.0[#]							

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^{61}Zn ε decay (89.1 s) 1970Ho29,1972Du09 (continued)

γ(^{61}Cu) (continued)

E_γ	I_γ[†@]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	δ[‡]	Comments
690.3 *1*	24.0 *18*	1660.44	3/2⁻	970.10	5/2⁻	M1(+E2)	+0.05 *19*	
697.6 *1*	5.5 *5*	2358.13	3/2⁻	1660.44	3/2⁻			
751.6 *1*	4.0 *5*	2840.53	1/2⁻,3/2⁻	2088.86	(1/2)⁻			
919.6 *3*	1.2 *2*	1394.52	5/2⁻	474.98	1/2⁻	E2		
934.4 *3*	1.1 *5*	1904.5	5/2⁻	970.10	5/2⁻	M1+E2	−0.14 *4*	
970.0[#] *3*	33.0[#] *15*	970.10	5/2⁻	0.0	3/2⁻	M1+E2	−0.35 *4*	
1131.9[#] *8*	2.3[#] *14*	2792.98	5/2⁻	1660.44	3/2⁻			
[x]1147.3 *3*	2.0 *3*							
1185.3 *3*	22.1 *14*	1660.44	3/2⁻	474.98	1/2⁻	M1+E2		δ: ≥0.26 and ≤1.00 from (α,pγ).
1311.0 *1*	12.0 *2*	1310.94	7/2⁻	0.0	3/2⁻	E2		
1394.6 *1*	15.6 *4*	1394.52	5/2⁻	0.0	3/2⁻	M1+E2	−3.55 *18*	
1457.8 *1*	4.0 *12*	1932.60	3/2⁻	474.98	1/2⁻	M1+E2	+0.20 *10*	
1482.1 *1*	10.1 *3*	2792.98	5/2⁻	1310.94	7/2⁻			
1502.4 *1*	1.8 *2*	2472.50	3/2⁻	970.10	5/2⁻			
1538.9 *2*	1.09 *10*	2932.91	3/2⁻	1394.52	5/2⁻			
[x]1565.6[#] *14*	<1.4[#]							
1613.3 *2*	3.8 *3*	2088.86	(1/2)⁻	474.98	1/2⁻			
1660.4 *1*	100.0 *23*	1660.44	3/2⁻	0.0	3/2⁻	M1+E2	+0.39 *+10−18*	
1732.6[#] *15*	<1.8[#]	1732.4	7/2⁻	0.0	3/2⁻	E2		
1883.1 *3*	6.15 *12*	2358.13	3/2⁻	474.98	1/2⁻			
1904.1 *9*	1.17 *16*	1904.5	5/2⁻	0.0	3/2⁻	M1+E2	+0.68 *9*	
1932.4 *1*	8.5 *5*	1932.60	3/2⁻	0.0	3/2⁻	M1+E2	+0.26 *+12−8*	
1997.4 *2*	15.1 *4*	2472.50	3/2⁻	474.98	1/2⁻	M1(+E2)	−0.02 *5*	
2088.9 *1*	8.05 *13*	2088.86	(1/2)⁻	0.0	3/2⁻			
2209.0 *2*	10.8 *6*	2683.96	3/2⁻	474.98	1/2⁻			
2358.6 *3*	4.2 *3*	2358.13	3/2⁻	0.0	3/2⁻			
2381.4 *20*	1.4 *2*	2857.1	1/2⁻,3/2⁻	474.98	1/2⁻			
2457.6 *4*	8.4 *5*	2932.91	3/2⁻	474.98	1/2⁻			
2472.1[#] *20*	1.0[#] *4*	2472.50	3/2⁻	0.0	3/2⁻			
2543.9 *30*	0.97 *18*	3019.3	3/2⁻	474.98	1/2⁻	M1+E2	−0.6 *4*	
2683.3 *6*	8.7 *6*	2683.96	3/2⁻	0.0	3/2⁻			
2792.3 *3*	10.3 *3*	2792.98	5/2⁻	0.0	3/2⁻			
2842.8 *6*	3.18 *3*	2840.53	1/2⁻,3/2⁻	0.0	3/2⁻			
2857.0 *3*	5.5 *8*	2857.1	1/2⁻,3/2⁻	0.0	3/2⁻			
2931.8 *3*	1.2 *3*	2932.91	3/2⁻	0.0	3/2⁻			
3019.3 *11*	2.4 *3*	3019.3	3/2⁻	0.0	3/2⁻			
3092.3 *13*	1.5 *3*	3092.4	3/2⁻	0.0	3/2⁻			
3521.1 *15*	1.8 *4*	3521.2	1/2⁻,3/2⁻,5/2⁻	0.0	3/2⁻			

[†] From 1970Ho29.
[‡] From Adopted Gammas.
[#] From 1972Du09.
[@] For absolute intensity per 100 decays, multiply by 0.0766 *38*.
[x] γ ray not placed in level scheme.

^{61}Zn ε decay (89.1 s) 1970Ho29,1972Du09

Decay Scheme

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