^{76}Zn β^- decay (5.7 s) 1986Ek01,2022Ch09

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh, Jun Chen and Ameenah R. Farhan	NDS 194,3 (2024)	8-Jan-2024

Parent: ^{76}Zn: E=0.0; $J^\pi=0^+$; $T_{1/2}$=5.7 s *3*; Q(β^-)=3993.6 *24*; %β^- decay=100

^{76}Zn-$T_{1/2}$: From ^{76}Zn Adopted Levels.

^{76}Zn-Q(β^-): From 2021Wa16.

1986Ek01: ^{76}Zn produced as a fission fragment at the OSIRIS-ISOL in Studsvik. Measured Eγ, Iγ, $\gamma\gamma$-coin and $\beta\gamma$-coin.

2022Ch09: ^{76}Zn activity obtained as daughter of ^{76}Cu decay, the latter produced in ^{9}Be(^{86}Kr,X),E=140 MeV/nucleon, and ^{76}Cu fragments separated by A1900 fragment separator at NSCL-MSU. Separated ^{76}Cu ion beam was delivered to an experimental station consisting of three Si detectors for particle identification based on ΔE-tof measurement. The ion beam was finally implanted in a $CeBr_3$ scintillator detector, coupled to a position-sensitive photomultiplier tube (PSPMT). Measured Eγ, Iγ, $\gamma\gamma$(t) and $\beta\gamma$(t), half-life of a new isomer at 199 keV. Comparison with shell-model calculations.

Others:

1981Ru07: γ-spectrum of A=76 nuclides.

1977Al17: $\beta\gamma$-coin data for four gate positions.

1975Al11, 1984Ha58: β^- strength functions.

1988BaZX, 1981Gi17, 1974Gr29, 1970OsZZ: $T_{1/2}$ (^{76}Zn) and isotope production.

β^- systematics: 1983Be56.

^{76}Ga Levels

E(level)†	J^π‡	$T_{1/2}$	Comments
0.0	$2^{(-)}$	30.5 s *4*	
172.29 *3*	$(1^+,2^+,3^+)$		
199.50 *3*	1^+	34 ns *8*	$T_{1/2}$: 34 ns *1*(stat) *8*(syst) from 2022Ch09, weighted average of 33.9 ns *11* from (γ rays in coin with the 199γ)(199γ)(t) and 30 ns *4* from $\beta\gamma$(t). Evaluators combined statistical and systematic uncertainties in quadrature. Structure of this isomeric state is proposed as a highly-mixed state of negative-parity proton configurations coupled to $1/2^-$ neutron configurations (2022Ch09).
275.28 *3*	1^+		
281.57 *3*			
369.81 *6*			
565.53 *3*	1^+		
680.83 *3*			
781.55 *5*			
1030.30 *3*	1^+		
1106.03 *8*	(1)		
1545.44 *3*	1^+		
1568.12 *4*	1^+		
1621.22 *8*	(1^+)		
1750.14 *3*	1^+		
1810.50 *6*	(1^+)		
1825.99 *7*	1^+		
1896.05 *6*	(1)		
1977.41 *6*	(1^+)		
2091.02 *4*	1^+		
2166.64 *12*	(1^+)		
2422.73 *11*	1^+		
2602.44 *11*	1^+		

† From a least-squares fit to Eγ data.

‡ From Adopted Levels.

^{76}Zn β^- decay (5.7 s) 1986Ek01,2022Ch09 (continued)

β^- radiations

av Eβ: Additional information 1.

E(decay)	E(level)	Iβ^-[†‡]	Log *ft*	Comments
(1391.2 *26*)	2602.44	0.13 *2*	5.32 *+10−9*	av Eβ=530.3 *11*
(1570.9 *26*)	2422.73	0.17 *2*	5.42 *+8−7*	av Eβ=610.9 *11*
(1827.0 *26*)	2166.64	0.16 *2*	5.71 *8*	av Eβ=727.5 *11*
(1902.6 *26*)	2091.02	2.1 *2*	4.66 *7*	av Eβ=762.3 *11* E(decay): 1980 *170* from (2091γ)β-coin (1986Ek01).
(2016.2 *26*)	1977.41	0.24 *4*	5.71 *+10−9*	av Eβ=814.8 *11*
(2097.6 *26*)	1896.05	0.13 *2*	6.05 *+10−9*	av Eβ=852.5 *11*
(2167.6 *26*)	1825.99	0.86 *16*	5.29 *+11−10*	av Eβ=885.1 *11* E(decay): 2380 *220* from (1456γ)β-coin (1986Ek01).
(2183.1 *26*)	1810.50	0.31 *4*	5.74 *8*	av Eβ=892.3 *11*
(2243.5 *26*)	1750.14	2.00 *11*	4.98 *5*	av Eβ=920.5 *11* E(decay): 2440 *140* from (1468γ)β-coin (1986Ek01). Other: 2400 *210* from (1069γ)β-coin (1986Ek01).
(2372.4 *26*)	1621.22	0.36 *4*	5.83 *+8−7*	av Eβ=980.9 *11*
(2425.5 *26*)	1568.12	0.97 *6*	5.44 *5*	av Eβ=1005.8 *11* E(decay): 2730 *160* from (1286γ)β-coin (1986Ek01).
(2448.2 *26*)	1545.44	4.1 *3*	4.83 *6*	av Eβ=1016.5 *11* E(decay): 2630 *220* from (1346γ)β-coin (1986Ek01). Others from 1986Ek01: 2570 *110*, 2530 *180* for gates at 1545γ, 1264γ, respectively.
(2887.6 *26*)	1106.03	0.16 *3*	6.55 *+11−10*	av Eβ=1224.2 *11*
(2963.3 *26*)	1030.30	10.7 *5*	4.77 *4*	av Eβ=1260.1 *11* E(decay): 3120 *90* from (858γ)β-coin (1986Ek01). Others from 1986Ek01: 3100 *100*, 3210 *170*, 3190 *120*, 3190 *190* for gates at 749γ, 755γ, 831γ, 1030γ, respectively. From (282γ)β-coin, Eβ=2770 *370* (1977Al17). In 1977Al17, 282γ was incorrectly placed from a 1312 level.
(3212.1 *26*)	781.55	0.10 *4*	6.95 *+25−17*	av Eβ=1378.7 *11*
(3312.8 *26*)	680.83	0.59 *18*	6.24 *+18−14*	av Eβ=1426.8 *11*
(3428.1 *26*)	565.53	11.0 *6*	5.03 *5*	av Eβ=1481.9 *11* E(decay): 3540 *190* from (366γ)β-coin (1986Ek01). Others: from (290γ)β-coin, Eβ=3460 *250* (1986Ek01), 3420 *610* (1977Al17). From (366γ)β-coin, Eβ=3530 *210* (1977Al17).
(3623.8[#] *26*)	369.81	<0.4	>6.6	av Eβ=1575.7 *12*
(3712.0[#] *26*)	281.57	2.7 *21*	5.8 *+7−3*	av Eβ=1618.0 *12*
(3718.3 *26*)	275.28	29 *5*	4.77 *+11−9*	av Eβ=1621.0 *12*
(3794.1 *26*)	199.50	33 *6*	4.75 *+11−10*	av Eβ=1657.4 *12* E(decay): 3720 *140* from (199γ)β-coin (1977Al17).
(3821.3[#] *26*)	172.29	0.8 *5*	6.4 *+4−2*	av Eβ=1670.5 *12*
(3993.6[#] *28*)	0.0	<0.3	>8.5[1u]	av Eβ=1755.3 *11*

[†] From γ+ce intensity balance at each level.
[‡] Absolute intensity per 100 decays.
[#] Existence of this branch is questionable.

γ(^{76}Ga)

Iγ normalization: Summed transition intensity to g.s.=99.85 *15*, assuming <0.3% feeding to the g.s. consistent with log $f^{1u}t$>8.5 for first forbidden unique (0^+ to $2^{(-)}$) β transition.

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^{76}Zn β^- decay (5.7 s) 1986Ek01,2022Ch09 (continued)

$\gamma(^{76}Ga)$ (continued)

E_γ[†]	I_γ[†#]	E_i(level)	J_i^π	E_f	J_f^π	Mult.	α[@]	Comments
75.9 *5*	32 *5*	275.28	1^+	199.50	1^+	(M1)[‡]	0.149	α(K)=0.132 *3*; α(L)=0.0141 *4*; α(M)=0.00207 *5*; α(N)=0.000109 *3*
82.1 *3*	3.6 *3*	281.57		199.50	1^+	[D,E2]	0.8 *7*	γ not observed by 2022Ch09.
88.3 *2*	0.3 *1*	369.81		281.57		[D,E2]	0.8 *7*	
94.53 *5*	0.9 *1*	369.81		275.28	1^+	[D,E2]	0.5 *4*	γ not observed by 2022Ch09.
102.88 *5*	1.7 *2*	275.28	1^+	172.29	$(1^+,2^+,3^+)$	(E2)[‡]	0.629	α(K)=0.551 *8*; α(L)=0.0682 *10*; α(M)=0.00985 *14*; α(N)=0.000423 *6*
109.23 *8*	0.6 *1*	281.57		172.29	$(1^+,2^+,3^+)$	[D,E2]	0.28 *23*	
172.44 *5*	9.6 *3*	172.29	$(1^+,2^+,3^+)$	0.0	$2^{(-)}$	(D)[‡]	0.014 *2*	
199.2 *5*	100 *2*	199.50	1^+	0.0	$2^{(-)}$	(E1)[‡]	0.00815 *13*	Iγ=100 (2022Ch09). B(E1)=0.016×10^{-6} e^{2}b *1*(stat) *4*(syst) (2022Ch09).
275.34 *5*	6.4 *4*	275.28	1^+	0.0	$2^{(-)}$			
281.56 *5*	4.0 *3*	281.57		0.0	$2^{(-)}$			
290.23 *8*	1.2 *2*	565.53	1^+	275.28	1^+			
365.98 *5*	9.7 *4*	565.53	1^+	199.50	1^+			Iγ=8.8 *12* (2022Ch09).
393.20 *5*	1.6 *3*	565.53	1^+	172.29	$(1^+,2^+,3^+)$			
405.5 *1*	0.10 *3*	680.83		275.28	1^+			
481.42 *5*	0.40 *4*	680.83		199.50	1^+			
508.8 *2*	1.0 *2*	680.83		172.29	$(1^+,2^+,3^+)$			
565.52 *5*	2.0 *3*	565.53	1^+	0.0	$2^{(-)}$			
609.29 *5*	0.33 *3*	781.55		172.29	$(1^+,2^+,3^+)$			
680.70 *4*	0.20 *3*	680.83		0.0	$2^{(-)}$			Eγ: somewhat poor fit in the level scheme, level-energy difference=680.82.
736.21 *6*	0.20 *3*	1106.03	(1)	369.81				
748.72 *5*	3.7 *4*	1030.30	1^+	281.57				Iγ=1.5 *4* (2022Ch09).
755.03 *2*	5.3 *3*	1030.30	1^+	275.28	1^+			Iγ=4.6 *9* (2022Ch09).
763.9 *1*	0.04 *2*	1545.44	1^+	781.55				
786.5 *1*	0.04 *2*	1568.12	1^+	781.55				
830.7 *5*	2.2 *2*	1030.30	1^+	199.50	1^+			Iγ=1.9 *5* (2022Ch09).
857.98 *5*	1.5 *2*	1030.30	1^+	172.29	$(1^+,2^+,3^+)$			
864.59 *5*	0.40 *5*	1545.44	1^+	680.83				
968.7 *2*	0.07 *1*	1750.14	1^+	781.55				
979.85 *5*	0.38 *5*	1545.44	1^+	565.53	1^+			
1030.26 *5*	0.92 *5*	1030.30	1^+	0.0	$2^{(-)}$			
1069.22 *5*	0.45 *5*	1750.14	1^+	680.83				
1184.49 *8*	0.13 *3*	1750.14	1^+	565.53	1^+			
1251.40 *5*	0.46 *5*	1621.22	(1^+)	369.81				
1263.89 *5*	1.6 *2*	1545.44	1^+	281.57				Iγ=0.9 *3* (2022Ch09).
1286.53 *5*	0.73 *5*	1568.12	1^+	281.57				Iγ=0.6 *3* (2022Ch09).
1309.6 *1*	0.05 *2*	2091.02	1^+	781.55				
1345.94 *5*	1.8 *2*	1545.44	1^+	199.50	1^+			Iγ=2.6 *6* (2022Ch09).
1368.59 *4*	0.31 *3*	1568.12	1^+	199.50	1^+			
1373.1 *1*	0.07 *2*	1545.44	1^+	172.29	$(1^+,2^+,3^+)$			
1395.94 *7*	0.15 *2*	1568.12	1^+	172.29	$(1^+,2^+,3^+)$			
1410.2 *1*	0.10 *2*	2091.02	1^+	680.83				
1456.16 *4*	1.1 *2*	1825.99	1^+	369.81				Iγ=1.5 *4* (2022Ch09).
1468.53 *5*	1.2 *1*	1750.14	1^+	281.57				Iγ=0.9 *3* (2022Ch09).
1545.48 *5*	0.98 *5*	1545.44	1^+	0.0	$2^{(-)}$			
1550.60 *7*	0.18 *2*	1750.14	1^+	199.50	1^+			
1578.00 *5*	0.28 *3*	1750.14	1^+	172.29	$(1^+,2^+,3^+)$			Eγ: somewhat poor fit in the level

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^{76}Zn β^- decay (5.7 s) 1986Ek01,2022Ch09 (continued)

$\gamma(^{76}Ga)$ (continued)

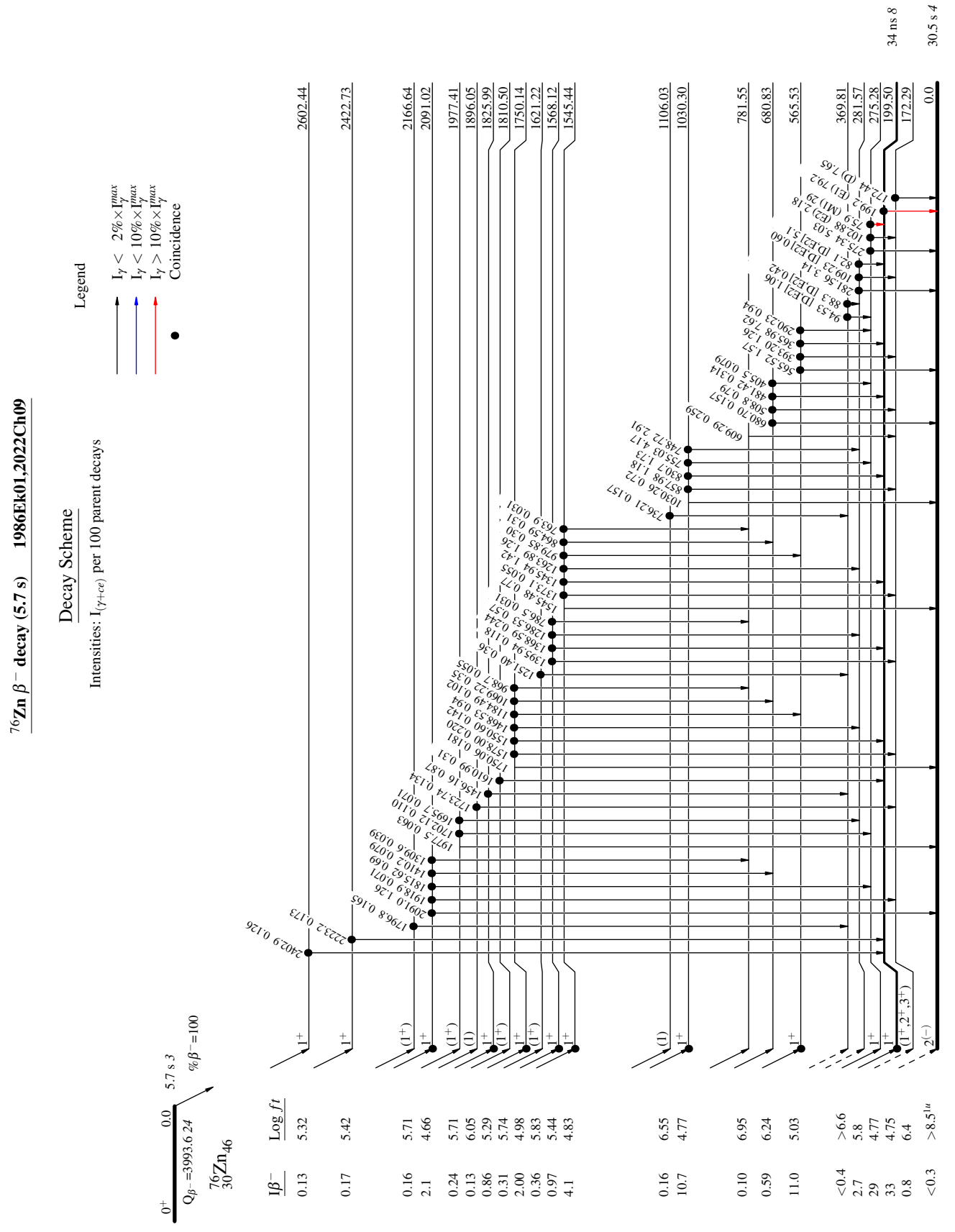
E_γ[†]	I_γ[†#]	E_i(level)	J_i^π	E_f	J_f^π	Comments
						scheme, level-energy difference=1577.82.
1610.99 *5*	0.39 *5*	1810.50	(1^+)	199.50	1^+	
1695.7 *1*	0.09 *3*	1977.41	(1^+)	281.57		
1702.12 *9*	0.14 *2*	1977.41	(1^+)	275.28	1^+	
1723.74 *5*	0.17 *2*	1896.05	(1)	172.29	$(1^+,2^+,3^+)$	
1750.06 *6*	0.23 *2*	1750.14	1^+	0.0	$2^{(-)}$	
1796.8 *1*	0.21 *2*	2166.64	(1^+)	369.81		
1815.62 *5*	0.88 *5*	2091.02	1^+	275.28	1^+	Iγ=1.4 *5* (2022Ch09).
1918.9 *1*	0.09 *2*	2091.02	1^+	172.29	$(1^+,2^+,3^+)$	
1977.5 *1*	0.08 *2*	1977.41	(1^+)	0.0	$2^{(-)}$	
2091.0 *1*	1.6 *2*	2091.02	1^+	0.0	$2^{(-)}$	
2223.2 *1*	0.22 *2*	2422.73	1^+	199.50	1^+	
2402.9 *1*	0.16 *2*	2602.44	1^+	199.50	1^+	

[†] From 1986Ek01. 2022Ch09 report data for only 12 γ rays, taking Eγ values from 1986Ek01. Intensities in 2022Ch09 seem to be nominal values which are listed under comments.

[‡] From the decay scheme in Fig.6 of 1986Ek01, probably deduced by the authors based on their measured ce data which however are not given in the paper.

[#] For absolute intensity per 100 decays, multiply by 0.786 *14*.

[@] 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.


76Zn β− decay (5.7 s) 1986Ek01,2022Ch09
Decay Scheme
Intensities: I(γ+ce) per 100 parent decays
Legend
Iγ < 2%×Iγmax
Iγ < 10%×Iγmax
Iγ > 10%×Iγmax
Coincidence
76 30Zn46
0+ 0.0 5.7 s 3
Qβ− =3993.6 24
%β−=100
Iβ− Log ft
0.13 5.32
0.17 5.42
0.16 5.71
2.1 4.66
0.24 5.71
0.13 6.05
0.86 5.29
0.31 5.74
2.00 4.98
0.36 5.83
0.97 5.44
4.1 4.83
0.16 6.55
10.7 4.77
0.10 6.95
0.59 6.24
11.0 5.03
<0.4 >6.6
2.7 5.8
29 4.77
33 4.75
0.8 6.4
<0.3 >8.5lu
2602.44
2422.73
2166.64
2091.02
1977.41
1896.05
1825.99
1810.50
1750.14
1621.22
1568.12
1545.44
1106.03
1030.30
781.55
680.83
565.53
369.81
281.57
275.28
199.50
172.29
0.0
34 ns 8
30.5 s 4
76 31Ga45