^{109}Tc β^- decay 1992PeZX,1989Gr23

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	S. Kumar(a), J. Chen(b) and F. G. Kondev	NDS 137, 1 (2016)	31-May-2016

Parent: ^{109}Tc: E=0.0; J^π=(5/2$^+$); $T_{1/2}$=0.91 s *3*; Q(β^-)=6456 *13*; %β^- decay=100.0

1992PeZX: Activity from ^{238}U(p,f) E_p=25 MeV, IGISOL. Detectors: planar Ge detectors for x ray, large coaxial HPGe detectors for γ rays, plastic scintillators for β particles. Measured Eγ, Iγ, E(x-ray), I(x-ray), $\gamma\gamma$-coin, γ(x-ray)γ-coin, γ(t), E(ce), I(ce). Deduced levels, J^π, $T_{1/2}$, γ-ray branching ratios, conversion coefficients, γ-ray multipolarities.

1989Gr23: Activity from ^{239}Pu(n,f) on-line mass separator LOHENGRIN at ILL, Grenoble. Detectors: plastic scintillator telescope, Ge(I). Measured: Eγ, Iγ, $\beta\gamma$ coin., α(K)exp, $\gamma\gamma$ coin, $\beta\gamma$(t).

Others: 1995Sc24: activity from ^{249}Cf(n,f), radiochemical separation, online SISAK Method. Measured: $\beta\gamma$(t); Detectors: thin plastic scintillator, two Ge(Li). 1999Ge01: activity from ^{241}Pu(n,f) on-line ms LOHENGRIN. Measured γ, γ(t) 1990Al43: activity from ^{249}Cf(n,f), radiochemical separation. Detectors: Planar HPGe (2 cm^3) and co-axial Ge(Li) (159 cm^3) and HPGe (75 cm^3). Measured: Eγ, Iγ, $\gamma\gamma$(t).

^{109}Ru Levels

E(level)†	J^π‡	$T_{1/2}$	Comments
0.0	(5/2$^+$)	34.4 s *2*	$T_{1/2}$: from Adopted Levels.
68.76 *12*	(1/2$^+$)	0.50 μs *20*	$T_{1/2}$: From 1992PeZX (using 68.8γ(t)).
96.09 *15*	(5/2$^-$)	0.68 μs *3*	$T_{1/2}$: From γ(t) in 1999Ge01. Other: 0.75 μs *15* (1976ChZD), 0.54 μs *17* (1992PeZX, using 96.1γ(t)).
131.80 *16*	(7/2$^-$)		
137.84 *12*	(3/2$^-$)	1.44 ns *11*	$T_{1/2}$: Using 137.9γ(t) (1995Sc24).
190.9 *3*	(3/2$^-$)		
194.89 *17*	(3/2,5/2,7/2)$^+$	0.20 ns *6*	$T_{1/2}$: Using 195γ(t) (1995Sc24).
197.41 *14*	(3/2$^-$)		
230.0 *3*	(9/2$^-$)		
255.57 *14*	(3/2$^+$)		
332.05 *20*	(7/2$^+$)		E(level): Also from coincidence of 138γ and 195γ (1990Al43,1989Gr23).
405.42 *19*	(3/2,5/2,7/2$^-$)		
514.57 *17*	(3/2,5/2$^+$)	0.16 ns *13*	$T_{1/2}$: Using 445.8γ(t) (1995Sc24).
627.97 *16*	(3/2$^+$,5/2,7/2$^-$)		
995.0 *3*	(3/2,5/2,7/2$^-$)		
1159.29 *19*	(3/2,5/2,7/2)		
1268.2 *3*	(3/2,5/2,7/2)		
1502.6 *3*	(3/2,5/2,7/2)		
1964.49 *24*	(3/2$^+$,5/2,7/2)		

† From a least-square fit to Eγ.

‡ From Adopted Levels.

β^- radiations

The decay scheme is incomplete (pandemonium). Thus, Iβ and log *ft* values are tentative and given as approximate.

E(decay)	E(level)	Iβ^-†	Log *ft*	Comments
(5188 *13*)	1268.2	≈2.77	≈5.8	av Eβ=2298.5 *63*
(5297 *13*)	1159.29	≈4.50	≈5.6	av Eβ=2350.6 *63*
(5461 *13*)	995.0	≈2.31	≈6.0	av Eβ=2429.2 *63*
(5828 *13*)	627.97	≈3.11	≈6.0	av Eβ=2604.9 *63*
(5941 *13*)	514.57	≈8.49	≈5.6	av Eβ=2659.2 *63*

Continued on next page (footnotes at end of table)

^{109}Tc β^- decay 1992PeZX,1989Gr23 (continued)

β^- radiations (continued)

E(decay)	E(level)	Iβ^-[†]	Log *ft*	Comments
(6051 *13*)	405.42	≈2.05	≈6.2	av Eβ=2711.5 *63*
(6124 *13*)	332.05	≈3.58	≈6.0	av Eβ=2746.6 *63*
(6200 *13*)	255.57	≈4.48	≈5.9	av Eβ=2783.2 *63*
(6226 *13*)	230.0	≈0.71	≈8.7[1u]	av Eβ=2782.8 *63*
(6259 *13*)	197.41	≈3.81	≈6.0	av Eβ=2811.1 *63*
(6261 *13*)	194.89	≈13.4	≈5.5	av Eβ=2812.3 *63*
(6265 *13*)	190.9	≈1.52	≈6.4	av Eβ=2814.2 *63*
(6318 *13*)	137.84	≈2.1	≈6.3	av Eβ=2839.6 *63*
(6324 *13*)	131.80	≈4.0	≈6.0	av Eβ=2842.5 *63*
(6360 *13*)	96.09	≈1.9	≈6.4	av Eβ=2859.6 *63*
(6387 *13*)	68.76	≈6.2	≈5.9	av Eβ=2872.7 *63*
(6456 *13*)	0.0	35 *6*	≈5.1	av Eβ=2905.6 *63*
				Iβ$^-$: From 2012Ku28.

[†] Absolute intensity per 100 decays.

$\gamma(^{109}Ru)$

Iγ normalization: From ΣI(γ+ce)[g.s.(^{109}Ru)]= 65% 6, using Iβ_0=35% 6, reported for the g.s. to g.s. decay in 2012Ku28. Other: 0.19 *3*, deduced from %γ/fission of 0.167% 10 (128.5γ) from 1969WiZX and the cumulative fission yield of 0.190% 25 for ^{109}Tc from JEFF3.1.1 data library. Since the decay scheme is incomplete (pandemonium), NR and %Iγ are tentative and given as approximate.

E$_\gamma$ [†]	I$_\gamma$ [†d]	E$_i$(level)	J$_i^\pi$	E$_f$	J$_f^\pi$	Mult. [@&]	α [b]	Comments
35.7 *2*	4.6 *3*	131.80	(7/2$^-$)	96.09	(5/2$^-$)	M1	6.02 *13*	α(K)=5.24 *12*; α(L)=0.644 *14*; α(M)=0.118 *3* α(N)=0.0191 *5*; α(O)=0.000972 *22* %Iγ≈0.57, using the calculated normalization. Mult.: α(K)exp=5.2 *14* (1992PeZX).
58.2 *2*	3.3 *4*	255.57	(3/2$^+$)	197.41	(3/2$^-$)	E1	0.657 *12*	α(K)=0.572 *10*; α(L)=0.0703 *13*; α(M)=0.01278 *22* α(N)=0.00200 *4*; α(O)=8.45×10^{-5} *15* %Iγ≈0.41, using the calculated normalization. Mult.: α(K)exp=0.6 *3* (1992PeZX).
68.8 *2*	33.5 *14*	68.76	(1/2$^+$)	0.0	(5/2$^+$)	E2	4.97 *9*	α(K)=3.61 *7*; α(L)=1.116 *22*; α(M)=0.211 *4* α(N)=0.0310 *6*; α(O)=0.000496 *9* %Iγ≈4.1, using the calculated normalization. E$_\gamma$: Other: 68.7 *3* (1990Al43). I$_\gamma$: Other: 54 *5*, includes also Iγ(69.1γ) (1990Al43). Mult.: α(K)exp=3.5 *9* and K/L=3.0 *2* (1992PeZX).
69.1 *2*	30.6 *15*	137.84	(3/2$^-$)	68.76	(1/2$^+$)	[E1]	0.403 *7*	α(K)=0.352 *6*; α(L)=0.0426 *7*; α(M)=0.00774 *13* α(N)=0.001216 *20*; α(O)=5.31×10^{-5} *9* %Iγ≈3.8, using the calculated normalization. I$_\gamma$: Other: 54 *5*, includes also Iγ(68.8γ) (1990Al43).
96.2 *2*	44.3 *9*	96.09	(5/2$^-$)	0.0	(5/2$^+$)	E1	0.1557	α(K)=0.1362 *21*; α(L)=0.01614 *25*; α(M)=0.00294 *5* α(N)=0.000465 *7*; α(O)=2.14×10^{-5} *4* %Iγ≈5.5, using the calculated normalization. E$_\gamma$: Other: 95.9 *3* in 1990Al43. I$_\gamma$: Other: 64 *6* in 1990Al43. Mult.: α(K)exp=0.13 *2* (1992PeZX).
98.2 *2*	4.0 *3*	230.0	(9/2$^-$)	131.80	(7/2$^-$)	(M1)	0.326	α(K)=0.284 *5*; α(L)=0.0344 *6*; α(M)=0.00632 *10* α(N)=0.001021 *16*; α(O)=5.27×10^{-5} *8* %Iγ≈0.50, using the calculated normalization. Mult.: α(K)exp=0.26 *5* for both 98.2γ and 98.9γ (1992PeZX).
98.9 *2*	2.6 *4*	194.89	(3/2,5/2,7/2)$^+$	96.09	(5/2$^-$)	(E1)	0.1438	α(K)=0.1257 *19*; α(L)=0.01488 *23*; α(M)=0.00271 *5* α(N)=0.000429 *7*; α(O)=1.98×10^{-5} *3* %Iγ≈0.32, using the calculated normalization. Mult.: α(K)exp=0.26 *5* for both 98.2γ and 98.9γ (1992PeZX).
117.7 *2*	8.3 *8*	255.57	(3/2$^+$)	137.84	(3/2$^-$)	E1	0.0870	α(K)=0.0761 *12*; α(L)=0.00894 *14*; α(M)=0.001629 *25* α(N)=0.000259 *4*; α(O)=1.220×10^{-5} *18* %Iγ≈1.03, using the calculated normalization. Mult.: α(K)exp=0.09 *5* (1992PeZX).

$^{109}_{44}Ru_{65}$-3

^{109}Tc β^- decay 1992PeZX,1989Gr23 (continued)

$\gamma(^{109}Ru)$ (continued)

E_γ [†]	I_γ [†d]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [@&]	δ [@ac]	α [b]	Comments
122.2 *4*	19.0 *10*	190.9	(3/2$^-$)	68.76	(1/2$^+$)	E1		0.0780 *14*	α(K)=0.0683 *12*; α(L)=0.00801 *14*; α(M)=0.001460 *25* α(N)=0.000232 *4*; α(O)=1.099×10^{-5} *19* %Iγ≈2.4, using the calculated normalization. Mult.: α(K)exp=0.080 *14* (1992PeZX).
128.7 *2*	45.0 *10*	197.41	(3/2$^-$)	68.76	(1/2$^+$)	E1+M2	0.152 *+21−24*	0.095 *8*	α(K)=0.082 *7*; α(L)=0.0105 *11*; α(M)=0.00193 *20* α(N)=0.00031 *4*; α(O)=1.46×10^{-5} *15* %Iγ≈5.6, using the calculated normalization. E_γ: Other: 128.4 *3* (1990Al43). I_γ: Other: 54 *5* (1990Al43). Mult.,δ: α(K)exp=0.087 *7* (1992PeZX).
131.8 *2*	5.2 *5*	131.80	(7/2$^-$)	0.0	(5/2$^+$)	(E1)		0.0627	α(K)=0.0549 *8*; α(L)=0.00643 *10*; α(M)=0.001171 *18* α(N)=0.000187 *3*; α(O)=8.90×10^{-6} *13* %Iγ≈0.64, using the calculated normalization.
134.2 *5*	0.28 *2*	230.0	(9/2$^-$)	96.09	(5/2$^-$)	[E2]		0.452 *9*	α(K)=0.372 *8*; α(L)=0.0660 *14*; α(M)=0.0123 *3* α(N)=0.00188 *4*; α(O)=5.67×10^{-5} *11* %Iγ≈0.035, using the calculated normalization. E_γ,I_γ: From Adopted Levels and Iγ(98.2γ)=4.0.
137.9 *2*	24.0 *14*	137.84	(3/2$^-$)	0.0	(5/2$^+$)	E1		0.0551	α(K)=0.0482 *7*; α(L)=0.00563 *9*; α(M)=0.001027 *15* α(N)=0.0001636 *24*; α(O)=7.84×10^{-6} *12* %Iγ≈3.0, using the calculated normalization. E_γ: Others:137.8 *3* (1990Al43), 137.7 *3* (1989Gr23). I_γ: Other: 27 *3* (1990Al43). Mult.,δ: α(K)exp=0.084 *10* (1992PeZX).
[x]172.0 *2*	2.5 *6*								%Iγ≈0.31, using the calculated normalization.
186.8 *2*	13.3 *5*	255.57	(3/2$^+$)	68.76	(1/2$^+$)	M1+E2	0.5 *3*	0.073 *16*	α(K)=0.063 *13*; α(L)=0.0082 *23*; α(M)=0.00152 *43* α(N)=2.41×10^{-4} *65*; α(O)=1.10×10^{-5} *19* %Iγ≈1.65, using the calculated normalization. Mult.,δ: α(K)exp=0.066 *12* (1992PeZX).
195.0 *3*	100.0 *20*	194.89	(3/2,5/2,7/2)$^+$	0.0	(5/2$^+$)	M1		0.0500	α(K)=0.0437 *7*; α(L)=0.00520 *8*; α(M)=0.000955 *14* α(N)=0.0001544 *23*; α(O)=8.07×10^{-6} *12* %Iγ≈12.4, using the calculated normalization. E_γ: Others: 194.9 *3* (1990Al43), 194.6 *3* (1989Gr23). I_γ: Other: 100 *5* (1990Al43). Mult.: α(K)exp=0.039 *4* and K/L=6.6 *20* (1992PeZX).
197.4 *2*	6.8 *10*	197.41	(3/2$^-$)	0.0	(5/2$^+$)	[E1]		0.0197	α(K)=0.01730 *25*; α(L)=0.00200 *3*; α(M)=0.000365 *6* α(N)=5.85×10^{-5} *9*; α(O)=2.89×10^{-6} *5* %Iγ≈0.84, using the calculated normalization.
[x]200.5 *4*	≤2.6								%Iγ≈0.16, using the calculated normalization. I_γ: ≤2.0 *6* in 1992PeZX.
208.0 *2*	20.0 *9*	405.42	(3/2,5/2,7/2$^-$)	197.41	(3/2$^-$)				%Iγ≈2.5, using the calculated normalization. E_γ: Other: 208.0 *3* (1990Al43). I_γ: Other: 32 *3* (1990Al43).
[x]242.2 *3*	2.9 *5*								%Iγ≈0.36, using the calculated normalization.

^{109}Tc β^- decay 1992PeZX,1989Gr23 (continued)

$\gamma(^{109}Ru)$ (continued)

E_γ[†]	I_γ[†d]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[@&]	α[b]	Comments
255.6 *3*	7.2 *5*	255.57	(3/2$^+$)	0.0	(5/2$^+$)	[M1]	0.0247	α(K)=0.0216 *3*; α(L)=0.00254 *4*; α(M)=0.000467 *7* α(N)=7.55×10^{-5} *11*; α(O)=3.97×10^{-6} *6* %Iγ≈0.89, using the calculated normalization.
267.7 *3*	3.6 *6*	405.42	(3/2,5/2,7/2$^-$)	137.84	(3/2$^-$)			%Iγ≈0.45, using the calculated normalization.
[x]278.8 *3*	3.7 *6*							%Iγ≈0.46, using the calculated normalization.
[x]289.5 *3*	9.3 *7*							%Iγ≈1.15, using the calculated normalization.
295.7[‡] *3*		627.97	(3/2$^+$,5/2,7/2$^-$)	332.05	(7/2$^+$)			
[x]300.4 *4*	3.5 *5*							%Iγ≈0.43, using the calculated normalization.
324.0 *5*	≤2.6	514.57	(3/2,5/2$^+$)	190.9	(3/2$^-$)			%Iγ≈0.16, using the calculated normalization. Iγ: ≤1.8 *7* in 1992PeZX.
332.0[#] *3*	28.5 *9*	332.05	(7/2$^+$)	0.0	(5/2$^+$)	[M1]	0.01268	α(K)=0.01111 *16*; α(L)=0.001298 *19*; α(M)=0.000238 *4* α(N)=3.86×10^{-5} *6*; α(O)=2.04×10^{-6} *3* %Iγ≈3.5, using the calculated normalization. Eγ: Other: 331.9 *3* (1989Gr23).
[x]336.9 *5*	1.2 *6*							%Iγ≈0.15, using the calculated normalization.
376.7 *3*	19.2 *8*	514.57	(3/2,5/2$^+$)	137.84	(3/2$^-$)			%Iγ≈2.38, using the calculated normalization.
445.8 *2*	22.7 *9*	514.57	(3/2,5/2$^+$)	68.76	(1/2$^+$)			%Iγ≈2.8, using the calculated normalization.
490.2 *2*	19.1 *10*	627.97	(3/2$^+$,5/2,7/2$^-$)	137.84	(3/2$^-$)			%Iγ≈2.4, using the calculated normalization.
514.5 *3*	25.3 *13*	514.57	(3/2,5/2$^+$)	0.0	(5/2$^+$)			%Iγ≈3.1, using the calculated normalization.
531.2[‡] *3*		1159.29	(3/2,5/2,7/2)	627.97	(3/2$^+$,5/2,7/2$^-$)			
589.7 *3*	7.1 *7*	995.0	(3/2,5/2,7/2$^-$)	405.42	(3/2,5/2,7/2$^-$)			%Iγ≈0.88, using the calculated normalization.
627.9 *3*	6.0 *7*	627.97	(3/2$^+$,5/2,7/2$^-$)	0.0	(5/2$^+$)			%Iγ≈0.74, using the calculated normalization. Eγ: Other: 628.2 *3* (1989Gr23).
[x]739.4 *5*	6.6 *8*							%Iγ≈0.82, using the calculated normalization.
804.0 *3*	6.9 *9*	995.0	(3/2,5/2,7/2$^-$)	190.9	(3/2$^-$)			%Iγ≈0.85, using the calculated normalization.
[x]848.1 *5*	11.4 *10*							%Iγ≈1.41, using the calculated normalization.
964.6[‡e] *3*		1159.29	(3/2,5/2,7/2)	194.89	(3/2,5/2,7/2)$^+$			
995.0 *5*	4.6 *8*	995.0	(3/2,5/2,7/2$^-$)	0.0	(5/2$^+$)			%Iγ≈0.57, using the calculated normalization.
1073.5[‡e] *3*		1268.2	(3/2,5/2,7/2)	194.89	(3/2,5/2,7/2)$^+$			
1158.7[#] *5*	36.3 *16*	1159.29	(3/2,5/2,7/2)	0.0	(5/2$^+$)			%Iγ≈4.5, using the calculated normalization. Eγ: Other: 1159.2 *3* (1989Gr23).
1267.8[#] *5*	22.3 *14*	1268.2	(3/2,5/2,7/2)	0.0	(5/2$^+$)			%Iγ≈2.8, using the calculated normalization. Eγ: Other: 1268.2 *3* (1989Gr23).
1502.6[‡] *3*		1502.6	(3/2,5/2,7/2)	0.0	(5/2$^+$)			
1632.6[‡] *3*		1964.49	(3/2$^+$,5/2,7/2)	332.05	(7/2$^+$)			
1964.3[‡] *3*		1964.49	(3/2$^+$,5/2,7/2)	0.0	(5/2$^+$)			

[†] From 1992PeZX, unless otherwise noted.
[‡] From 1989Gr23. Not seen in 1992PeZX.

$^{109}_{44}Ru_{65}$-5

^{109}Tc β^- decay 1992PeZX,1989Gr23 (continued)

$\gamma(^{109}Ru)$ (continued)

Placement by 1989Gr23. Unplaced in 1992PeZX.
@ From Adopted Gammas.
& Additional information 2.
a Additional information 3.
b Additional information 4.
c If No value given it was assumed δ=1.00 for E2/M1, δ=1.00 for E3/M2 and δ=0.10 for the other multipolarities.
d For absolute intensity per 100 decays, multiply by ≈0.124.
e Placement of transition in the level scheme is uncertain.
x γ ray not placed in level scheme.

$^{109}_{44}Ru_{65}$-6

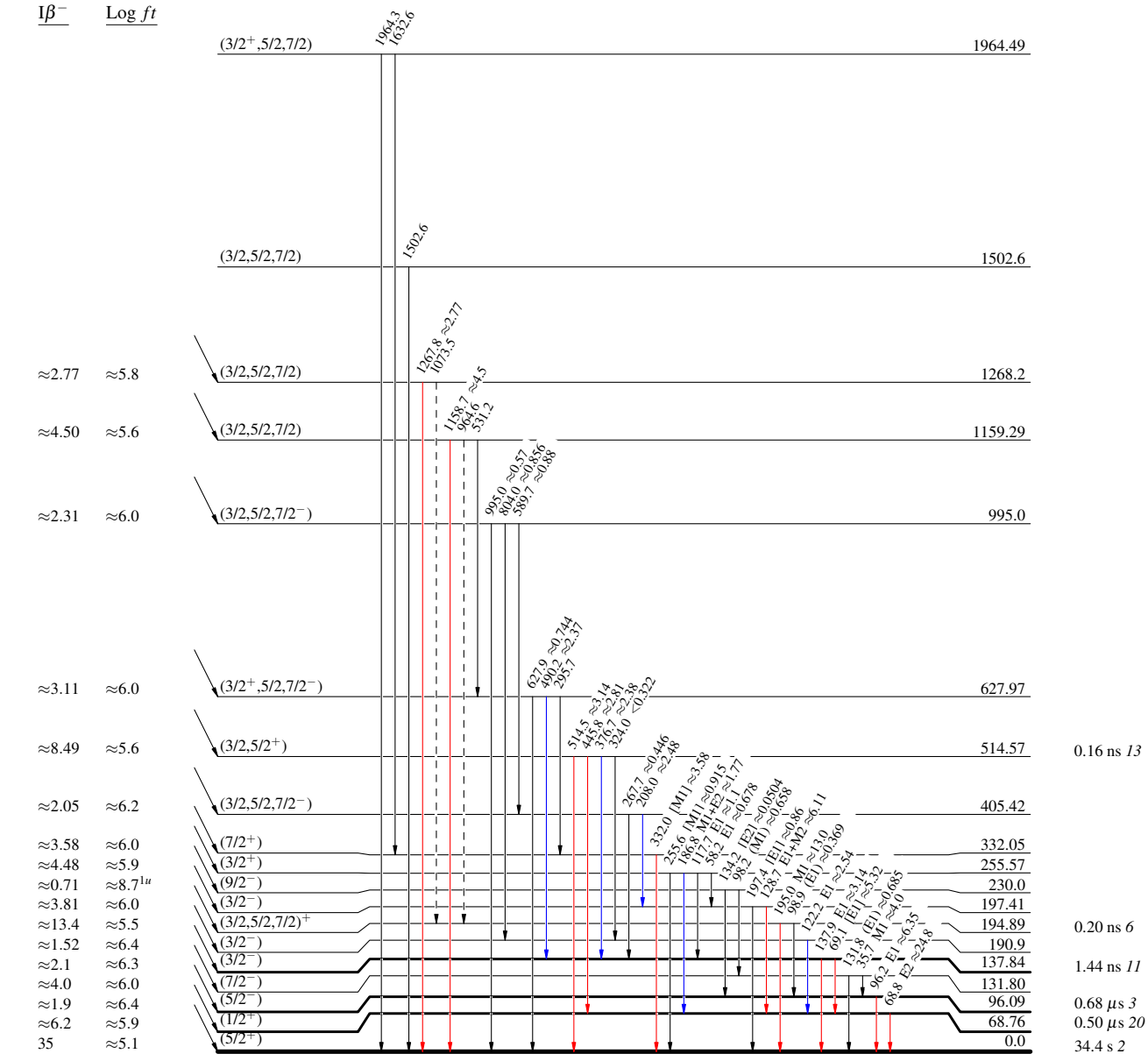
^{109}Tc β^- decay 1992PeZX,1989Gr23

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)

$(5/2^+)$ 0.0 0.91 s *3*
Q_{β^-}=6456 *13* $\%\beta^-$=100.0
$^{109}_{43}Tc_{66}$



$^{109}_{44}Ru_{65}$