^{93}Ru $\varepsilon+\beta^+$ decay (59.7 s) 1976De37

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Coral M. Baglin	NDS 112,1163 (2011)	15-Dec-2010

Parent: ^{93}Ru: E=0; $J^\pi=(9/2)^+$; $T_{1/2}$=59.7 s *6*; Q(ε)=6391 *6*; %ε+%β^+ decay=100

Others: 1983Ay01, 1972Do04.

1976De37:Ge(Li) detectors; measured Eγ, Iγ, $\gamma\gamma$ coin (time resolution 50 ns FWHM).

^{93}Tc Levels

E(level)[†]	J$^\pi$[‡]	$T_{1/2}$[#]	E(level)[†]	J$^\pi$[‡]
0	$9/2^+$		3914.76 *16*	$(7/2,9/2,11/2)^+$
392.63 *10*	$1/2^-$		4158.5 *3*	$(7/2,9/2,11/2)^+$
680.69 *9*	$(7/2^+)$	<35 ns	4187.4 *3*	$(7/2,9/2,11/2)^+$
1194.13 *10*	(≥7/2)	<35 ns	4344.4 *5*	(7/2,9/2,11/2)
1408.51 *14*	$(5/2^-)$	<35 ns	4389.6 *3*	$(7/2,9/2,11/2)^+$
1434.82 *10*	$(13/2)^+$	<35 ns	4608.9 *4*	$(7/2,9/2,11/2)^+$
1801.42 *10*	(7/2,9/2,11/2)		4619.0 *4*	$(7/2,9/2,11/2)^+$
1969.61 *20*	$(5/2^-,7/2,9/2^-)$		4668.81 *14*	$(9/2,11/2)^+$
2134.41 *24*	$5/2^-,7/2^-$		4760.7 *5*	(7/2,9/2,11/2)
2146.1 *4*	$(13/2)^-$		4775.1 *5*	$(7/2,9/2,11/2)^+$
2257.73 *10*	(7/2,9/2,11/2)		4937.9 *5*	$(7/2,9/2,11/2)^+$
2338.97[@] *14*			4955.0 *8*	$(7/2,9/2,11/2)^+$
2490.3 *4*			5298.2 *9*	$(7/2,9/2,11/2)^+$
2631.21 *22*	(7/2,9/2,11/2)			

[†] From least-squares fit to Eγ.
[‡] From Adopted Levels.
[#] From FWHM=50 ns time resolution for $\gamma\gamma$ coin (1976De37).
[@] Intensity balance at this level is 0.013% 23.

ε,β^+ radiations

E(decay)	E(level)	Iβ^+ [#]	Iε[#]	Log *ft*	I($\varepsilon+\beta^+$)[†#]	Comments
(1093 *6*)	5298.2		0.029 *8*	5.56 *12*	0.029 *8*	εK=0.8669; εL=0.10792 *2*; εM+=0.025186 *5*
(1436 *6*)	4955.0	0.00043 *8*	0.038 *7*	5.69 *8*	0.038 *7*	av Eβ=187.9 *27*; εK=0.8581 *6*; εL=0.10596 *8*; εM+=0.02470 *2*
(1453 *6*)	4937.9	0.00046 *11*	0.035 *8*	5.74 *10*	0.035 *8*	av Eβ=195.3 *26*; εK=0.8565 *6*; εL=0.10574 *9*; εM+=0.02465 *2*
(1616 *6*)	4775.1	0.0016 *3*	0.037 *7*	5.80 *8*	0.039 *7*	av Eβ=265.3 *26*; εK=0.8315 *13*; εL=0.10239 *17*; εM+=0.02386 *4*
(1630 *6*)	4760.7	0.0011 *3*	0.023 *7*	6.02 *13*	0.024 *7*	av Eβ=271.5 *26*; εK=0.8283 *14*; εL=0.10197 *18*; εM+=0.02376 *5*
(1722 *6*)	4668.81	0.041 *4*	0.52 *5*	4.71 *4*	0.56 *5*	av Eβ=311.2 *26*; εK=0.8041 *19*; εL=0.09887 *24*; εM+=0.02304 *6*
(1772 *6*)	4619.0	0.0077 *11*	0.075 *11*	5.57 *7*	0.083 *12*	av Eβ=332.8 *27*; εK=0.7881 *21*; εL=0.0969 *3*; εM+=0.02256 *6*
(1782 *6*)	4608.9	0.0087 *14*	0.081 *13*	5.54 *7*	0.090 *14*	av Eβ=337.2 *27*; εK=0.7846 *22*; εL=0.0964 *3*; εM+=0.02246 *7*
(2001 *6*)	4389.6	0.026 *3*	0.101 *13*	5.55 *6*	0.127 *16*	av Eβ=433.0 *27*; εK=0.692 *3*; εL=0.0848 *4*; εM+=0.01975 *9*
(2047 *6*)	4344.4	0.0074 *16*	0.025 *5*	6.18 *10*	0.032 *7*	av Eβ=452.9 *27*; εK=0.669 *3*; εL=0.0820 *4*; εM+=0.01910 *9*
(2204 *6*)	4187.4	0.028 *3*	0.058 *6*	5.88 *5*	0.086 *9*	av Eβ=522.4 *27*; εK=0.587 *4*; εL=0.0719 *4*; εM+=0.01674 *10*

Continued on next page (footnotes at end of table)

^{93}Ru $\varepsilon+\beta^+$ decay (59.7 s) 1976De37 (continued)

ϵ,β^+ radiations (continued)

E(decay)	E(level)	Iβ^+ #	Iε#	Log *ft*	I($\varepsilon+\beta^+$)†#	Comments
(2233 *6*)	4158.5	0.038 *3*	0.072 *7*	5.79 *4*	0.110 *10*	av Eβ=535.2 *27*; εK=0.572 *4*; εL=0.0700 *4*; εM+=0.01630 *10*
(2476 *6*)	3914.76	0.24 *2*	0.25 *2*	5.34 *4*	0.49 *4*	av Eβ=644.2 *27*; εK=0.447 *3*; εL=0.0547 *4*; εM+=0.01273 *9*
(3760 *6*)	2631.21	0.068 *9*	0.010 *1*	7.11 *6*	0.078 *10*	av Eβ=1234.2 *28*; εK=0.1122 *7*; εL=0.01364 *8*; εM+=0.003172 *19*
(3901 *6*)	2490.3	0.018 *4*	0.0023 *6*	7.79 *11*	0.020 *5*	av Eβ=1300.2 *29*; εK=0.0982 *6*; εL=0.01193 *7*; εM+=0.002775 *16*
(4133 *6*)	2257.73	0.19 *3*	0.019 *3*	6.91 *7*	0.21 *3*	av Eβ=1409.6 *29*; εK=0.0796 *5*; εL=0.00966 *6*; εM+=0.002247 *12*
(4245 *6*)	2146.1	0.044 *11*	0.010 *3*	9.05[1u] *12*	0.054 *14*	av Eβ=1472.4 *28*; εK=0.1605 *8*; εL=0.01967 *10*; εM+=0.004581 *24*
(4257 *6*)	2134.41	0.077 *8*	0.0069 *7*	7.38 *5*	0.084 *9*	av Eβ=1467.8 *29*; εK=0.0715 *4*; εL=0.00868 *5*; εM+=0.002020 *11*
(4421 *6*)	1969.61	0.184 *20*	0.0142 *16*	7.10 *5*	0.198 *22*	av Eβ=1545.7 *29*; εK=0.0623 *3*; εL=0.00757 *4*; εM+=0.001760 *9*
(4590 *6*)	1801.42	0.36 *4*	0.024 *3*	6.91 *5*	0.38 *4*	av Eβ=1625.5 *29*; εK=0.0545 *3*; εL=0.00661 *4*; εM+=0.001538 *8*
(4956 *6*)	1434.82	0.35 *5*	0.018 *2*	7.10 *6*	0.37 *5*	av Eβ=1800.0 *29*; εK=0.04137 *18*; εL=0.005017 *22*; εM+=0.001167 *5* Log *ft*: far too low for ΔJ=2, $\Delta\pi$=No feeding.
(4983 *6*)	1408.51	0.20 *4*	0.023 *5*	8.97[1u] *10*	0.22 *5*	av Eβ=1816.2 *29*; εK=0.0902 *4*; εL=0.01102 *5*; εM+=0.002566 *12*
(5197 *6*)	1194.13	0.22 *3*	0.0092 *12*	7.42 *6*	0.23 *3*	av Eβ=1915.0 *29*; εK=0.03495 *15*; εL=0.004238 *18*; εM+=0.000985 *4*
(5710 *6*)	680.69	5.3 *4*	0.16 *1*	6.27 *4*	5.5 *4*	av Eβ=2161.4 *29*; εK=0.02509 *10*; εL=0.003040 *12*; εM+=0.000707 *3*
6337 *85*	0	89.1 *6*	1.77 *2*	5.321 *6*	90.9‡ *6*	av Eβ=2489.9 *29*; εK=0.01698 *6*; εL=0.002056 *7*; εM+=0.0004779 *1* E(decay): from 1983Ay01: Si(Li)-telescope, Fermi-Kurie analysis.

† From I(γ+ce) imbalance At each level.

‡ %ε+%β^+ to (g.s.+393 level) is 90.9 *6*. Because J differs by 4 for these levels, the feeding to one must be first forbidden unique or higher; feeding to the other would then be allowed (*e.g.*, for 393 level, I($\varepsilon+\beta^+$)<2.5% if log $f^{1u}t$>8.5 and, for g.s., log *ft*<5.9 provided that I($\varepsilon+\beta^+$)>23%). The observed feeding to the (7/2$^+$) 681 level with log *ft*=6.25 *5* rules out an allowed transition to the (1/2)$^-$ 393 level. Thus, J$^\pi$(^{93}Ru)≥7/2$^+$ and feeding to the (1/2)$^-$ 393 level can be ignored.

Absolute intensity per 100 decays.

^{93}Ru $\varepsilon+\beta^+$ decay (59.7 s) 1976De37 (continued)

$\gamma(^{93}Tc)$

Iγ normalization: From I($\gamma^{\pm}$)/I(681γ)=32.6 *20* and I(γ+ce) imbalance, assuming Iε/Iβ(theory) and no feeding to 393 level (for which ΔJ=4).

E_γ [†]	I_γ [†@]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	δ[‡]	α[&]	Comments
392.65 *10*		392.63	1/2$^-$	0	9/2$^+$	M4		0.325	α(K)=0.271 *4*; α(L)=0.0449 *7*; α(M)=0.00840 *12*; α(N+..)=0.001381 *20* α(N)=0.001309 *19*; α(O)=7.23×10^{-5} *11*
561.2 *2*	20.4 *20*	1969.61	(5/2$^-$,7/2,9/2$^-$)	1408.51	(5/2$^-$)				
680.7 *1*	1000	680.69	(7/2$^+$)	0	9/2$^+$	(M1+E2)	0.7 *2*	0.00208 *3*	α(K)=0.00183 *3*; α(L)=0.000210 *4*; α(M)=3.81×10^{-5} *7*; α(N+..)=6.45×10^{-6} *10* α(N)=6.05×10^{-6} *10*; α(O)=4.03×10^{-7} *6*
711.3 *3*	9.2 *22*	2146.1	(13/2)$^-$	1434.82	(13/2)$^+$	E1		0.000707 *10*	α(K)=0.000623 *9*; α(L)=6.97×10^{-5} *10*; α(M)=1.259×10^{-5} *18*; α(N+..)=2.14×10^{-6} *3* α(N)=2.00×10^{-6} *3*; α(O)=1.341×10^{-7} *19*
725.9 *2*	14.3 *10*	2134.41	5/2$^-$,7/2$^-$	1408.51	(5/2$^-$)				
[x]789.4 *3*	10.2 *11*								
1015.9 *1*	72 *7*	1408.51	(5/2$^-$)	392.63	1/2$^-$	[E2]		0.000798 *12*	α(K)=0.000701 *10*; α(L)=8.02×10^{-5} *12*; α(M)=1.450×10^{-5} *21*; α(N+..)=2.46×10^{-6} α(N)=2.30×10^{-6} *4*; α(O)=1.526×10^{-7} *22*
1194.1 *1*	63 *4*	1194.13	(≥7/2)	0	9/2$^+$				
1288.7 *3*	13.2 *22*	1969.61	(5/2$^-$,7/2,9/2$^-$)	680.69	(7/2$^+$)				
1434.9 *1*	123 *6*	1434.82	(13/2)$^+$	0	9/2$^+$	E2		0.000443 *7*	α(K)=0.000336 *5*; α(L)=3.78×10^{-5} *6*; α(M)=6.83×10^{-6} *10*; α(N+..)=6.21×10^{-5} *9* α(N)=1.088×10^{-6} *16*; α(O)=7.34×10^{-8} *11*; α(IPF)=6.10×10^{-5} *9*
1576.0 *4*	8.9 *13*	3914.76	(7/2,9/2,11/2)$^+$	2338.97					
1658.7 *3*	5.3 *12*	2338.97		680.69	(7/2$^+$)				
1801.4 *1*	64 *3*	1801.42	(7/2,9/2,11/2)	0	9/2$^+$				
1809.6 *4*	3.4 *8*	2490.3		680.69	(7/2$^+$)				
1950.5 *2*	13.2 *13*	2631.21	(7/2,9/2,11/2)	680.69	(7/2$^+$)				
[x]1969.0 *2*	11.1 *11*								
2257.7 *1*	36 *4*	2257.73	(7/2,9/2,11/2)	0	9/2$^+$				
[x]2313.4 *7*	23 *3*								
2329.7 *2*	8.2 *14*	4668.81	(9/2,11/2)$^+$	2338.97					
2338.7 *2*	14 *3*	2338.97		0	9/2$^+$				
2720.4 *3*	21.8 *11*	3914.76	(7/2,9/2,11/2)$^+$	1194.13	(≥7/2)				
[x]2902.1 *3*	11.2 *20*								
[x]2929.6 *5*	10.0 *12*								
[x]3151.8 *3*	19.5 *20*								

$^{93}_{43}Tc_{50}$-3

^{93}Ru $\varepsilon+\beta^+$ decay (59.7 s) 1976De37 (continued)

$\gamma(^{93}Tc)$ (continued)

E_γ †	I_γ †@	E_i(level)	J_i^π	E_f	J_f^π	E_γ †	I_γ †@	E_i(level)	J_i^π	E_f	J_f^π
3234.3 *2*	51.6 *26*	4668.81	$(9/2,11/2)^+$	1434.82	$(13/2)^+$	4187.3# *3*	14.6 *10*	4187.4	$(7/2,9/2,11/2)^+$	0	$9/2^+$
x3331.8# *2*	37 *4*					4257.2 *5*	4.1 *10*	4937.9	$(7/2,9/2,11/2)^+$	680.69	$(7/2^+)$
x3418.5# *3*	25.5 *26*					4344.3# *5*	5.4 *11*	4344.4	$(7/2,9/2,11/2)$	0	$9/2^+$
x3434.4# *4*	10.4 *13*					4389.5# *3*	21.5 *22*	4389.6	$(7/2,9/2,11/2)^+$	0	$9/2^+$
3477.3 *6*	3.6 *5*	4158.5	$(7/2,9/2,11/2)^+$	680.69	$(7/2^+)$	4608.9# *4*	10.2 *17*	4608.9	$(7/2,9/2,11/2)^+$	0	$9/2^+$
x3509.3 *3*	11.0 *19*					4618.9# *4*	14.1 *17*	4619.0	$(7/2,9/2,11/2)^+$	0	$9/2^+$
3914.7# *2*	53 *3*	3914.76	$(7/2,9/2,11/2)^+$	0	$9/2^+$	4668.1# *3*	15.8 *17*	4668.81	$(9/2,11/2)^+$	0	$9/2^+$
3928.0 *5*	5.0 *10*	4608.9	$(7/2,9/2,11/2)^+$	680.69	$(7/2^+)$	4759.6# *10*	0.6 *3*	4760.7	$(7/2,9/2,11/2)$	0	$9/2^+$
3988.0 *3*	20.0 *25*	4668.81	$(9/2,11/2)^+$	680.69	$(7/2^+)$	4775.0# *10*	0.6 *3*	4775.1	$(7/2,9/2,11/2)^+$	0	$9/2^+$
4080.1 *5*	3.5 *10*	4760.7	$(7/2,9/2,11/2)$	680.69	$(7/2^+)$	4937.5# *10*	1.8 *6*	4937.9	$(7/2,9/2,11/2)^+$	0	$9/2^+$
4094.3 *5*	6.0 *10*	4775.1	$(7/2,9/2,11/2)^+$	680.69	$(7/2^+)$	4954.9# *8*	6.5 *10*	4955.0	$(7/2,9/2,11/2)^+$	0	$9/2^+$
4104.1 *10*	3.0 *10*	5298.2	$(7/2,9/2,11/2)^+$	1194.13	$(\geq 7/2)$	5297.9# *15*	1.9 *6*	5298.2	$(7/2,9/2,11/2)^+$	0	$9/2^+$
4158.5# *3*	15.1 *10*	4158.5	$(7/2,9/2,11/2)^+$	0	$9/2^+$						

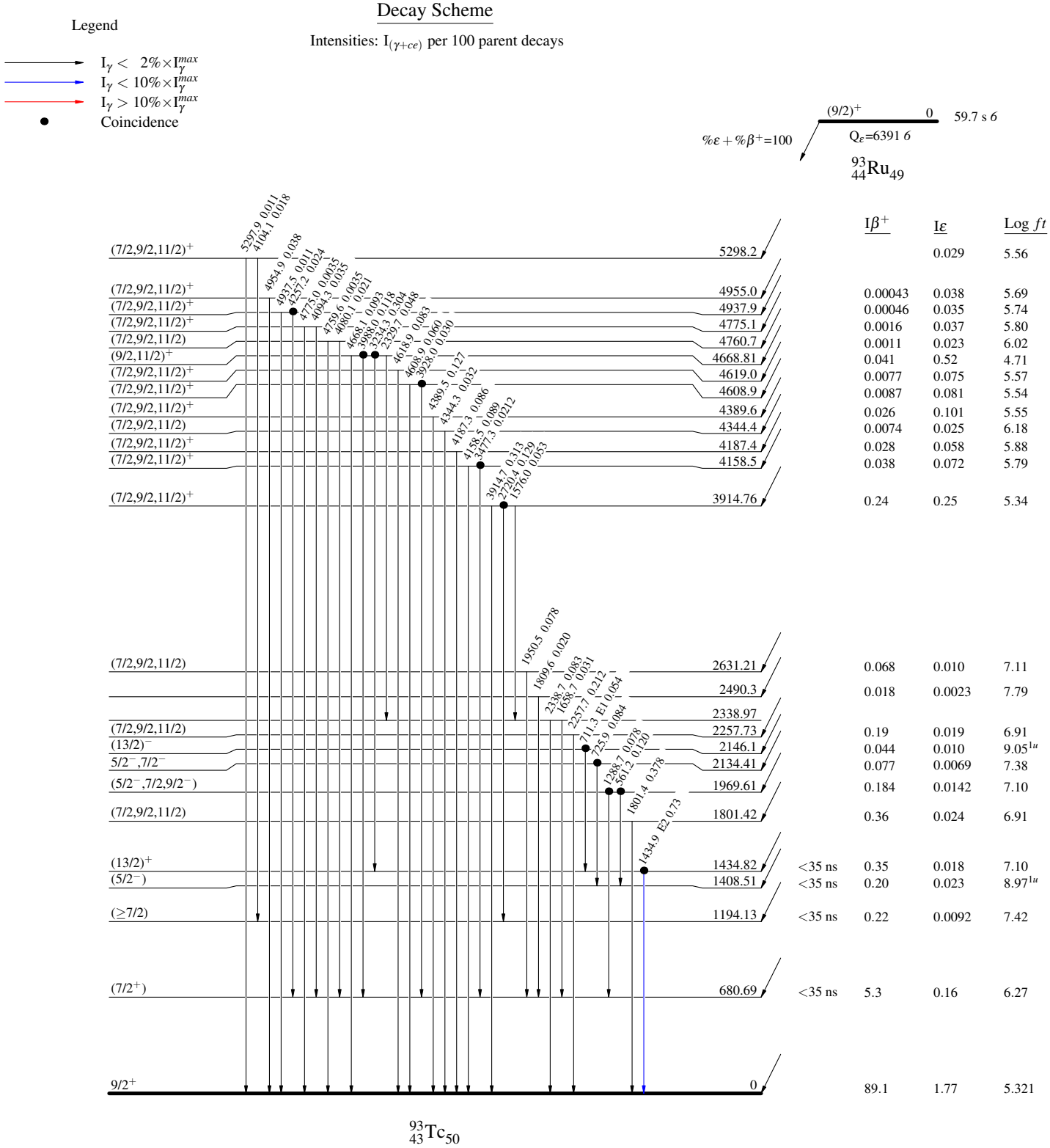
† From 1976De37.
‡ From Adopted Gammas.
# Not coincident with any γ or $\gamma^\pm$ (1976De37).
@ For absolute intensity per 100 decays, multiply by 0.0059 *4*.
& Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.
x γ ray not placed in level scheme.

$^{93}_{43}Tc_{50}$-4

^{93}Ru ε decay (59.7 s) 1976De37

Decay Scheme

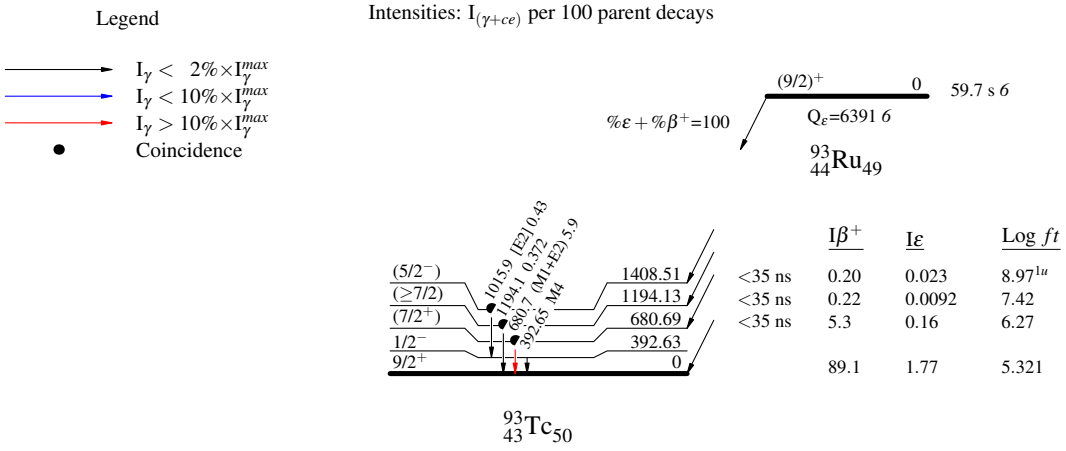
Intensities: $I_{(\gamma+ce)}$ per 100 parent decays



^{93}Ru ε decay (59.7 s) 1976De37

Decay Scheme (continued)

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



		Iβ+	Iε	Log *ft*
1408.51	<35 ns	0.20	0.023	8.97[1u]
1194.13	<35 ns	0.22	0.0092	7.42
680.69	<35 ns	5.3	0.16	6.27
392.63		89.1	1.77	5.321