^{100}Ru(n,n′γ),(n,n′) 2001Ge03

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh and Jun Chen	NDS 172, 1 (2021)	31-Jan-2021

2001Ge03: (n,n′γ) E=2.4-3.3 MeV neutron were produced via the ^{3}H(p,n) reaction with pulsed proton beams from the University of Kentucky accelerator. Target was a 4.78 g sample of metallic ruthenium (95.58% enriched in ^{100}Ru). γ rays were detected with a BGO-shielded HPGe detector. Measured Eγ, Iγ, γ(θ), Doppler-shift attenuation. Deduced levels, J, π, $T_{1/2}$, γ-ray multipolarities, transition strengths. Comparisons with available data and theoretical calculations.

Others:

1978AhZX: (n,n′γ) fast neutrons from a reactor. Measured γ. Five levels reported at 539, 1130, 1226, 1362 and 1742 with a total of six γ rays.

In (n,n′) work, only the first 2^+ state is studied.

1981Ko15: (n,n′) E(n)=525-1000 keV.

1980Ef01: (n,n′) E(n)=300 keV.

1976Ko14: (n,n′) E(n)=500=900 keV.

All data are from 2001Ge03.

^{100}Ru Levels

E(level)[†]	Jπ[‡]	$T_{1/2}$[#]	Comments
0.0	0^+		
539.506 *14*	2^+		
1130.295 *21*	0^+		
1226.465 *19*	4^+		
1362.164 *15*	2^+	0.95 ps *+24−16*	
1741.074 *25*	0^+	>1.39 ps	
1865.109 *19*	2^+	0.66 ps *+20−12*	
1881.036 *20*	3^+	0.90 ps *+40−22*	
2051.65 *4*	0^+	1.0 ps *+11−4*	$T_{1/2}$: 0.96 ps *+111−34*.
2062.69 *3*	4^+	0.56 ps *+92−22*	
2075.710 *24*	6^+	>0.28 ps	
2099.10 *3*	2^+	0.39 ps *+7−6*	
2166.88 *3*	3^-	>0.97 ps	
2240.81 *4*	2^+	83 fs *6*	
2351.23 *4*	4^+	0.42 ps *+26−12*	
2366.46 *5*	4^+	0.78 ps *+76−26*	
2387.18 *5*	0^+	>0.52 ps	
2413.95 *5*	(4^+)	87 fs *+7−6*	
2469.40 *4*	2^-	0.44 ps *+51−16*	
2493.05 *4*	4^-	>0.83 ps	Jπ: $(3^+,4^+,5^+)$ in the Adopted Levels.
2512.43 *4*	4^+	0.41 ps *+55−15*	
2516.80 *4*	1^-	105 fs *+43−26*	
2527.19 *4*	5^-	0.6 ps *+14−3*	
2536.21 *7*	3^+	0.7 ps *+12−3*	
2543.70 *3*	2^+	0.38 ps *+49−15*	
2569.99 *4*	3^-	>0.30 ps	
2576.84 *8*	5^+	>125 fs	
2591.85 *4*	4^-	0.26 ps *+62−12*	
2606.02 *10*	2,3	71 fs *+10−8*	Jπ: $(1^+,2,3^+,4^+)$ in the Adopted Levels.
2617.13 *9*	(1)	121 fs *+26−19*	Jπ: $(1,2^+)$ in the Adopted Levels.
2660.14 *10*	1	48 fs *+6−5*	Jπ: $(1,2^+)$ in the Adopted Levels.
2666.21 *11*	2,3	55 fs *+6−5*	Jπ: $(1^+,2,3^+)$ in the Adopted Levels.
2738.75 *23*			
2745.47 *19*	1	132 fs *+42−28*	Jπ: $(1,2^+)$ in the Adopted Levels.
2764.93 *8*	4^-	>0.17 ps	Jπ: $2^+,3^+$ in the Adopted Levels.
2775.33[@] *5*		0.30 ps *+24−10*	

Continued on next page (footnotes at end of table)

^{100}Ru(n,n′γ),(n,n′) 2001Ge03 (continued)

^{100}Ru Levels (continued)

E(level)[†]	Jπ[‡]	$T_{1/2}$[#]	Comments
2800.84 *5*		0.13 ps *+5–3*	
2801.47 *16*	3^+	97 fs *+17–13*	Jπ: $(1^+,2,3^+)$ in the Adopted Levels.
2837.78 *14*	2^+	116 fs *+21–17*	Jπ: $(1^+,2^+)$ in the Adopted Levels.
2862.53 *9*		0.25 ps *+51–10*	
2877.28 *19*	3^+		Jπ: $(2^+,3,4^+)$ in the Adopted Levels.
2878.44 *4*	$2^+,3,4^+$	140 fs *+30–21*	
2905.0 *3*	(4^+)	0.21 ps *+8–5*	
2915.48 *8*	2^-	0.35 ps *+29–11*	
2951.09 *8*		87 fs *+14–10*	
2998.93 *24*		0.18 ps *+10–5*	
3060.02 *24*	1	11 fs *3*	Jπ: $(1,2^+)$ in the Adopted Levels.
3064.80 *17*	4^+	37 fs *+10–7*	
3069.60 *18*		>0.45 ps	
3072.13 *11*	1	0.20 ps *+14–6*	Jπ: 2^+ in the Adopted Levels.
3110.68 *17*	4	>0.26 ps	Jπ: $(2^+,3^+)$ in the Adopted Levels.
3118.66 *13*		37 fs *+8–6*	

[†] From least-squares fit to Eγ data.
[‡] As proposed by 2001Ge03. Most are consistent with those in the Adopted Levels. The differences are noted.
[#] From DSA method (2001Ge03).
[@] There may be a doublet populated near this energy (see the Adopted Levels).

γ(^{100}Ru)

E_i(level)	J_i^π	E_γ	I_γ	E_f	J_f^π	Mult.[†]	δ[‡]	Comments
539.506	2^+	539.506 *18*	100	0.0	0^+	Q[@]		A_2=+0.153 *9*; A_4=−0.010 *5*
1130.295	0^+	590.774 *20*	100	539.506	2^+			
1226.465	4^+	686.963 *17*	100	539.506	2^+	Q[@]		A_2=+0.303 *6*; A_4=−0.047 *8*
1362.164	2^+	822.672 *16*	57.6 *3*	539.506	2^+	M1+E2	+3.7 *3*	A_2=+0.086 *8* δ: +3.7 *3* or −0.14 *3* (2001Ge03).
		1362.160 *21*	42.4 *3*	0.0	0^+	E2		A_2=+0.231 *15*; A_4=−0.021 *21*
1741.074	0^+	378.94 *3*	42.9 *6*	1362.164	2^+			
		1201.54 *3*	57.1 *6*	539.506	2^+			
1865.109	2^+	502.83 *6*	4.6 *1*	1362.164	2^+			
		638.72 *5*	4.3 *1*	1226.465	4^+			
		734.810 *21*	26.0 *2*	1130.295	0^+	E2		A_2=+0.304 *24*; A_4=−0.05 *3*
		1325.633 *22*	33.2 *3*	539.506	2^+	M1+E2	−1.0 *3*	A_2=−0.205 *29* δ: −1.0 *3* or −2.5 *9* (2001Ge03).
		1865.07 *6*	32.0 *4*	0.0	0^+	E2		A_2=+0.294 *16*; A_4=−0.043 *21*
1881.036	3^+	518.82 *3*	12.7 *3*	1362.164	2^+	M1+E2	+0.37 *7*	A_2=+0.31 *4*; A_4=+0.21 *4* δ: +0.36 *8* or +6.5 *14* (2001Ge03).
		654.60 *3*	8.6 *2*	1226.465	4^+	M1+E2	+2.3 *5*	A_2=−0.43 *4*; A_4=+0.09 *4* δ: +3.2 *6* or +0.46 *7* (2001Ge03).
		1341.515 *22*	78.7 *6*	539.506	2^+	M1+E2	+5.7 *5*	A_2=+0.276 *20*; A_4=+0.17 *3* δ: +6.7 *12* or +0.37 *10* (2001Ge03).
2051.65	0^+	689.46 *9*		1362.164	2^+			
		1512.13 *4*		539.506	2^+			
2062.69	4^+	700.51 *5*	22.6 *4*	1362.164	2^+			
		836.24 *3*	26.6 *1*	1226.465	4^+	M1+E2	+1.73 *17*	A_2=+0.24 *6*; A_4=−0.10 *7* δ: +1.5 *3* or −0.13 *7* (2001Ge03).
		1523.08 *6*	50.8 *7*	539.506	2^+	E2		A_2=+0.403 *24*; A_4=−0.13 *3*

Continued on next page (footnotes at end of table)

^{100}Ru(n,n′γ),(n,n′) 2001Ge03 (continued)

γ(^{100}Ru) (continued)

E_i(level)	J_i^π	E_γ	I_γ	E_f	J_f^π	Mult.[†]	δ[‡]	Comments
2075.710	6^+	849.241 *15*	100	1226.465	4^+			
2099.10	2^+	737.15 *6*	10.8 *6*	1362.164	2^+			
		872.67 *16*	1.3 *2*	1226.465	4^+			
		968.68 *10*	2.6 *2*	1130.295	0^+			
		1559.56 *3*	81.7 *7*	539.506	2^+			
		2099.03 *15*	3.5 *2*	0.0	0^+			
2166.88	3^-	301.82 *3*	10.7 *2*	1865.109	2^+	D(+Q)[&]	+0.04 *3*	A_2=−0.15 *4*; A_4=+0.14 *5* δ: +0.04 *4* (2001Ge03).
		1627.34 *4*	84.7 *8*	539.506	2^+	D(+Q)[&]	−0.003 *20*	A_2=−0.274 *20* δ: −0.008 *24* (2001Ge03).
		2166.61 *21*	4.6 *3*	0.0	0^+	(O)		A_2=+0.60 *10*; A_4=+0.09 *12* Mult.: 2001Ge03 assign (E3).
2240.81	2^+	375.73 *9*	1.6 *3*	1865.109	2^+			
		1701.28 *3*	98.4 *3*	539.506	2^+	D(+Q)[a]	−0.014 *50*	A_2=+0.159 *2*; A_4=+0.02 *3* δ: +2.7 *3* or −0.014 *50* (2001Ge03).
2351.23	4^+	1124.77 *3*	60.1 *11*	1226.465	4^+	M1+E2	−0.36[#] *5*	A_2=+0.16 *4*; A_4=+0.05 *5*
		1811.66 *8*	39.9 *11*	539.506	2^+	E2		A_2=+0.36 *6*; A_4=−0.09 *7*
2366.46	4^+	1139.88 *6*	16.5 *6*	1226.465	4^+			
		1827.04 *6*	83.5 *6*	539.506	2^+	E2		A_2=+0.42 *3*; A_4=−0.17 *5*
2387.18	0^+	1025.00 *5*	56.6 *11*	1362.164	2^+			
		1847.73 *11*	43.4 *11*	539.506	2^+			
2413.95	(4^+)	1051.96 *7*	13.2 *4*	1362.164	2^+			
		1874.29 *6*	86.8 *4*	539.506	2^+	(E2)		A_2=+0.309 *20*; A_4=−0.02 *3*
2469.40	2^-	588.25 *8*	16.6 *4*	1881.036	3^+	D(+Q)[&]	+0.14[#] *16*	A_2=−0.14 *4*
		1107.29 *5*	45.3 *7*	1362.164	2^+	D(+Q)[&]	−0.10 *13*	A_2=+0.21 *6*; A_4=+0.07 *7* δ: −0.10 *13* or +1.8 *3* (2001Ge03).
		1929.80 *7*	38.1 *7*	539.506	2^+	D(+Q)[&]	−0.8 *9*	A_2=+0.18 *5*; A_4=−0.08 *7* δ: −0.8 *9* or +2.9 *8* (2001Ge03).
2493.05	4^-	430.32 *6*	27.7 *11*	2062.69	4^+			A_2=+0.62; A_4=+0.15
		612.01 *5*	11.5 *11*	1881.036	3^+			
		1266.66 *10*	60.9 *12*	1226.465	4^+	D(+Q)[&]	+0.4[#] *6*	A_2=+0.50 *9*
2512.43	4^+	413.28 *25*	8.9 *4*	2099.10	2^+			
		631.38 *3*	54.3 *9*	1881.036	3^+	M1+E2	+0.41[#] *5*	A_2=+0.25 *6*; A_4=−0.07 *6*
		1150.42 *10*	7.3 *6*	1362.164	2^+			
		1972.85 *9*	29.5 *7*	539.506	2^+	(E2)		A_2=+0.43 *11*; A_4=−0.05 *11*
2516.80	1^-	465.11 *15*	8.8 *8*	2051.65	0^+			
		651.72 *4*	26.9 *9*	1865.109	2^+			
		775.95 *13*	7.8 *5*	1741.074	0^+			
		1154.60 *8*	13.1 *7*	1362.164	2^+			
		1386.43 *6*	26.8 *8*	1130.295	0^+	D		A_2=−0.38 *17*
		1977.18 *13*	16.5 *6*	539.506	2^+			
2527.19	5^-	1300.71 *4*	100	1226.465	4^+	D(+Q)[&]	+0.004 *6*	A_2=−0.13 *9* δ: +0.05 *7* (2001Ge03).
2536.21	3^+	1309.94 *14*	10.5 *5*	1226.465	4^+			
		1996.62 *8*	89.5 *5*	539.506	2^+	D(+Q)[a]	+0.017[#] *30*	A_2=−0.20 *7*
2543.70	2^+	662.56 *25*	5.0 *9*	1881.036	3^+			
		678.59 *4*	26.0 *9*	1865.109	2^+			
		1181.53 *4*	40.6 *9*	1362.164	2^+	M1+E2	−0.12 *9*	δ: +3.5 *12* or −0.12 *9* (2001Ge03); note that no γ(θ) coefficients are available.
		2004.20 *12*	17.3 *7*	539.506	2^+			
		2543.4 *3*	11.1 *7*	0.0	0^+			
2569.99	3^-	403.14 *4*	42.6 *8*	2166.88	3^-	M1+E2	+1.58 *7*	A_2=+0.37 *8* δ: +0.08 *8* or +1.36 *20* (2001Ge03).

Continued on next page (footnotes at end of table)

^{100}Ru(n,n′γ),(n,n′) 2001Ge03 (continued)

γ(^{100}Ru) (continued)

E_i(level)	J_i^π	E_γ	I_γ	E_f	J_f^π	Mult.[†]	δ[‡]	Comments
2569.99	3⁻	1207.78 *6*	30.0 *9*	1362.164	2⁺			
		1343.39 *10*	21.8 *23*	1226.465	4⁺			
		2030.7 *3*	5.5 *6*	539.506	2⁺			
2576.84	5⁺	1350.37 *7*	100	1226.465	4⁺			
2591.85	4⁻	424.88 *17*	18.4 *6*	2166.88	3⁻			
		710.80 *3*	44.1 *11*	1881.036	3⁺	D(+Q)[&]	+0.03 *5*	A_2=−0.32 *15* δ: +0.02 *5* (2001Ge03).
		1365.49 *9*	37.5 *10*	1226.465	4⁺			
2606.02	2,3	2066.49 *9*	100	539.506	2⁺			A_2=+0.22 *7*; A_4=+0.04 *7*
2617.13	(1)	2617.09 *9*	100	0.0	0⁺			
2660.14	1	2120.57 *11*	82.2 *9*	539.506	2⁺			
		2660.22 *20*	17.8 *9*	0.0	0⁺			
2666.21	2,3	2126.68 *11*	100	539.506	2⁺			A_2=+0.19 *7*
2738.75		857.71 *23*	100	1881.036	3⁺			
2745.47	1	1615.4 *9*	71.0 *10*	1130.295	0⁺			
		2205.93 *19*	29.0 *10*	539.506	2⁺			
2764.93	4⁻	598.29 *15*	50.8 *16*	2166.88	3⁻			
		1538.38 *8*	49.2 *16*	1226.465	4⁺			
2775.33		248.11 *7*	13.3 *5*	2527.19	5⁻			This γ is most likely from a high-spin (5⁻) level near this energy. See comment for 2775 doublet in the Adopted Levels.
		1413.18 *7*	27.8 *7*	1362.164	2⁺			
		1548.74 *10*	15.0 *6*	1226.465	4⁺			
		2236.09 *17*	44.0 *11*	539.506	2⁺			
2800.84		1438.69 *5*	68.8 *9*	1362.164	2⁺	D(+Q)[&]	+0.01[#] *5*	A_2=−0.26 *7*
		1574.24 *11*	31.2 *9*	1226.465	4⁺			
2801.47	3⁺	920.6 *3*	16.5 *6*	1881.036	3⁺			
		2261.88 *18*	83.5 *6*	539.506	2⁺	M1+E2		A_2=+0.33 *6* δ: +0.42 *5* or +3.9 *8* (2001Ge03).
2837.78	2⁺	1475.67 *19*	8.5 *5*	1362.164	2⁺			
		2298.17 *20*	91.5 *5*	539.506	2⁺	M1+E2		A_2=+0.15 *6*; A_4=−0.04 *6* δ: +3.0 *5* or −0.07 *4* (2001Ge03); δ=−0.04 *6* in table 1 of 2001Ge03 is a misprint.
2862.53		763.33 *17*	11.9 *24*	2099.10	2⁺			
		1500.38 *10*	88.1 *24*	1362.164	2⁺			
2877.28	3⁺	1515.10 *19*	100	1362.164	2⁺			
2878.44	2⁺,3,4⁺	779.54 *10*	11.1 *5*	2099.10	2⁺			
		997.41 *5*	37.4 *7*	1881.036	3⁺			
		1651.89 *5*	51.5 *9*	1226.465	4⁺			
2905.0	(4⁺)	2365.50 *25*	100	539.506	2⁺	(E2)		A_2=+0.32 *9*; A_4=−0.04 *9*
2915.48	2⁻	446.04 *10*	17.1 *9*	2469.40	2⁻			
		1553.34 *11*	30.6 *9*	1362.164	2⁺			
		2376.1 *3*	52.4 *15*	539.506	2⁺			
2951.09		1589.1 *3*	7.7 *8*	1362.164	2⁺			
		1724.62 *8*	54.1 *12*	1226.465	4⁺			
		2411.41 *21*	38.2 *13*	539.506	2⁺			
2998.93		2459.39 *24*	100	539.506	2⁺			
3060.02	1	3059.97 *24*	100	0.0	0⁺			
3064.80	4⁺	2525.26 *17*	100	539.506	2⁺	E2		A_2=+0.18 *6*; A_4=−0.15 *7*
3069.60		2530.06 *18*	100	539.506	2⁺			
3072.13	1	1710.00 *12*	48.4 *18*	1362.164	2⁺			
		3071.86 *24*	51.6 *18*	0.0	0⁺			
3110.68	4	943.79 *16*	100	2166.88	3⁻			
3118.66		1756.21 *21*	25.4 *16*	1362.164	2⁺			
		2579.28 *16*	74.6 *16*	539.506	2⁺			

Continued on next page (footnotes at end of table)

^{100}Ru(n,n′γ),(n,n′) 2001Ge03 (continued)

γ(^{100}Ru) (continued)

† From γ(θ) data of 2001Ge03, RUL is used when level lifetime is available. The evaluators assign mult=Q when only γ(θ) data are available, 2001Ge03 assign E2 in such cases. For several ΔJ=1 transitions, the evaluators assign D(+Q) from γ(θ) data of 2001Ge03, whereas 2001Ge03 assign E1 or M1+E2.

‡ Adopted values from 2001Ge03 combine values deduced from their data and δ values from literature. Values obtained by 2001Ge03 are given under comments for such cases.

From 2001Ge03.

@ E2 (2001Ge03).

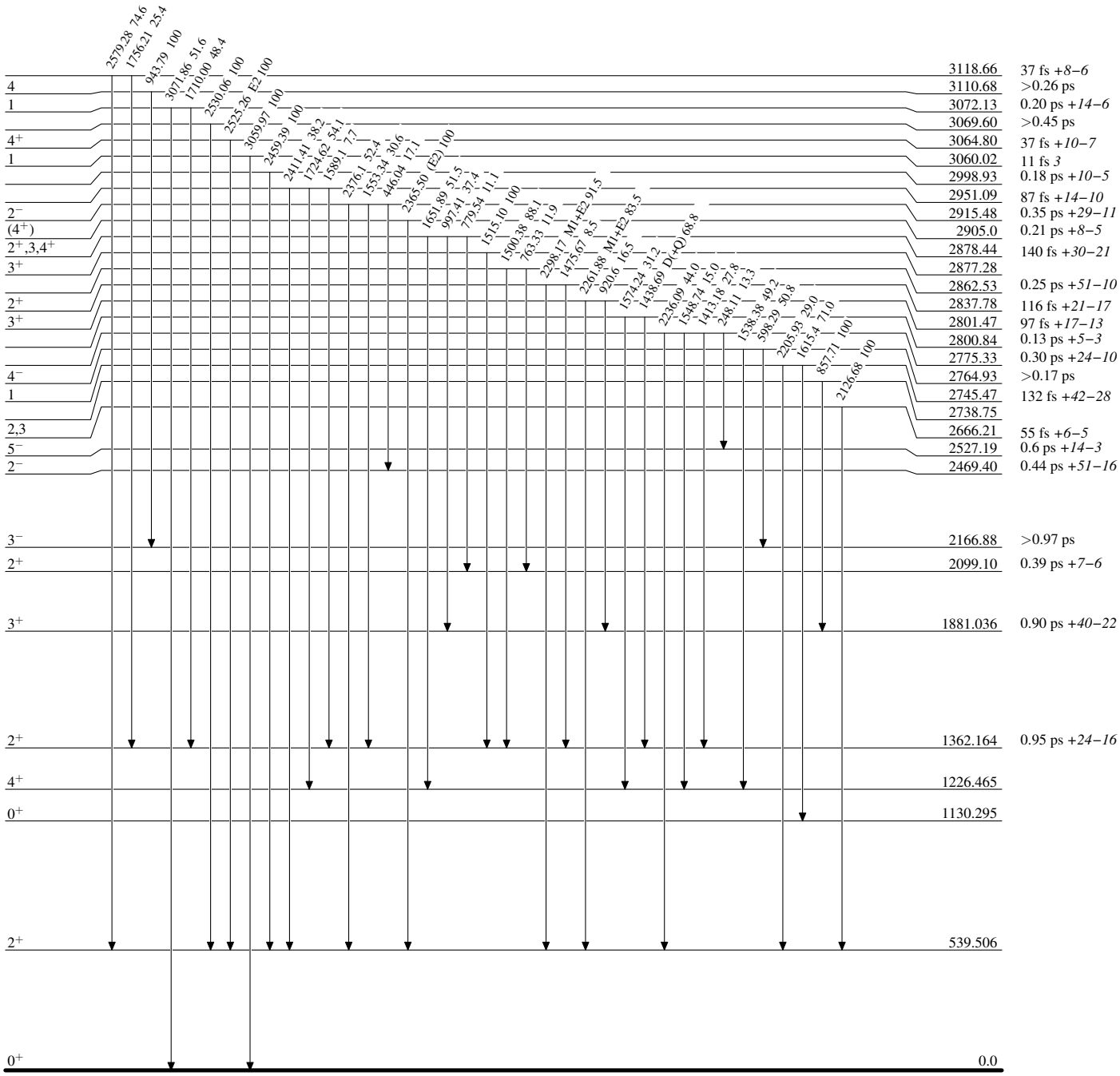
& E1 (2001Ge03).

a M1+E2 (2001Ge03).

^{100}Ru(n,n′γ),(n,n′) 2001Ge03

Level Scheme

Intensities: % photon branching from each level

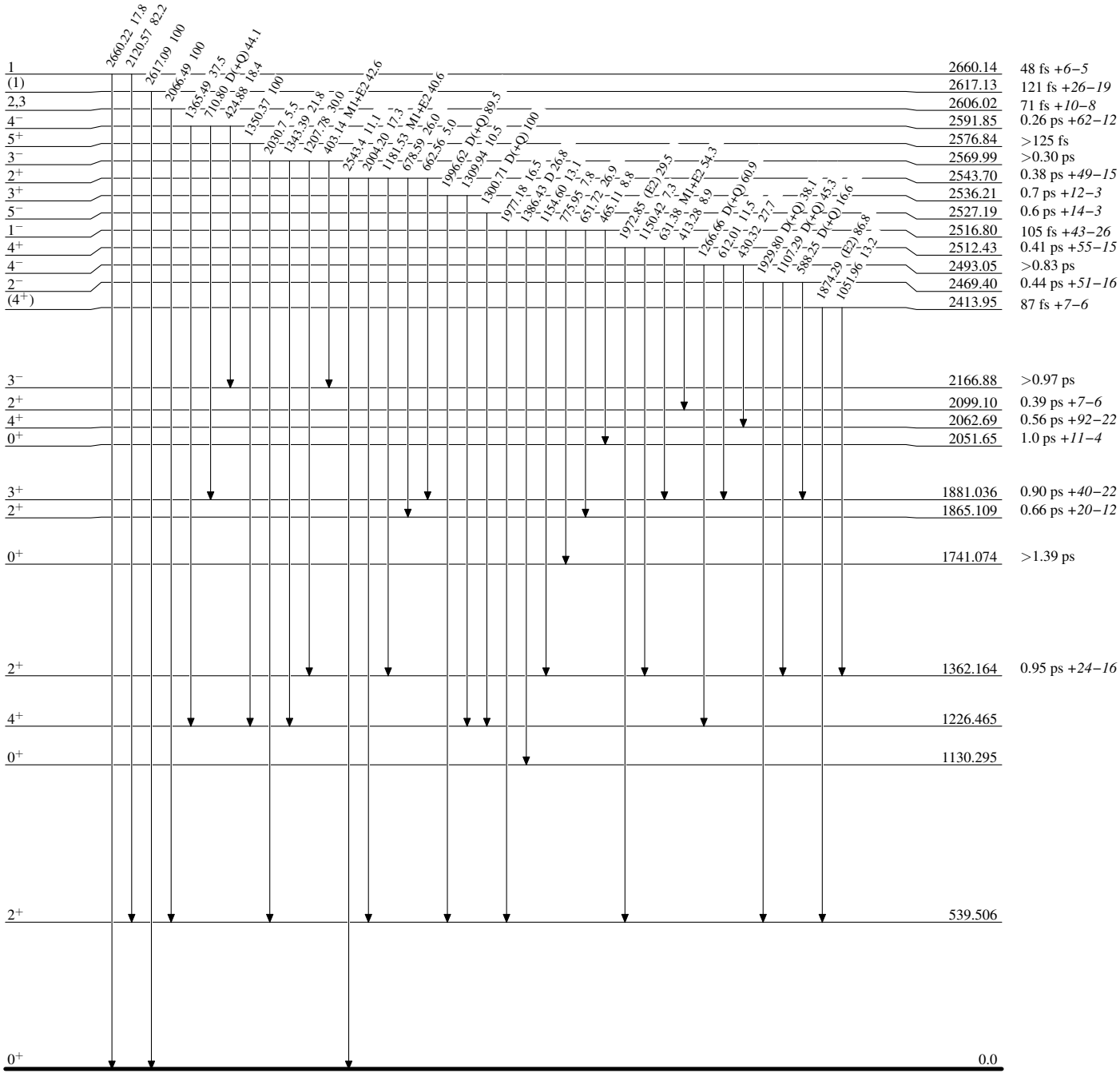


$^{100}_{44}Ru_{56}$

^{100}Ru(n,n′γ),(n,n′) 2001Ge03

Level Scheme (continued)

Intensities: % photon branching from each level

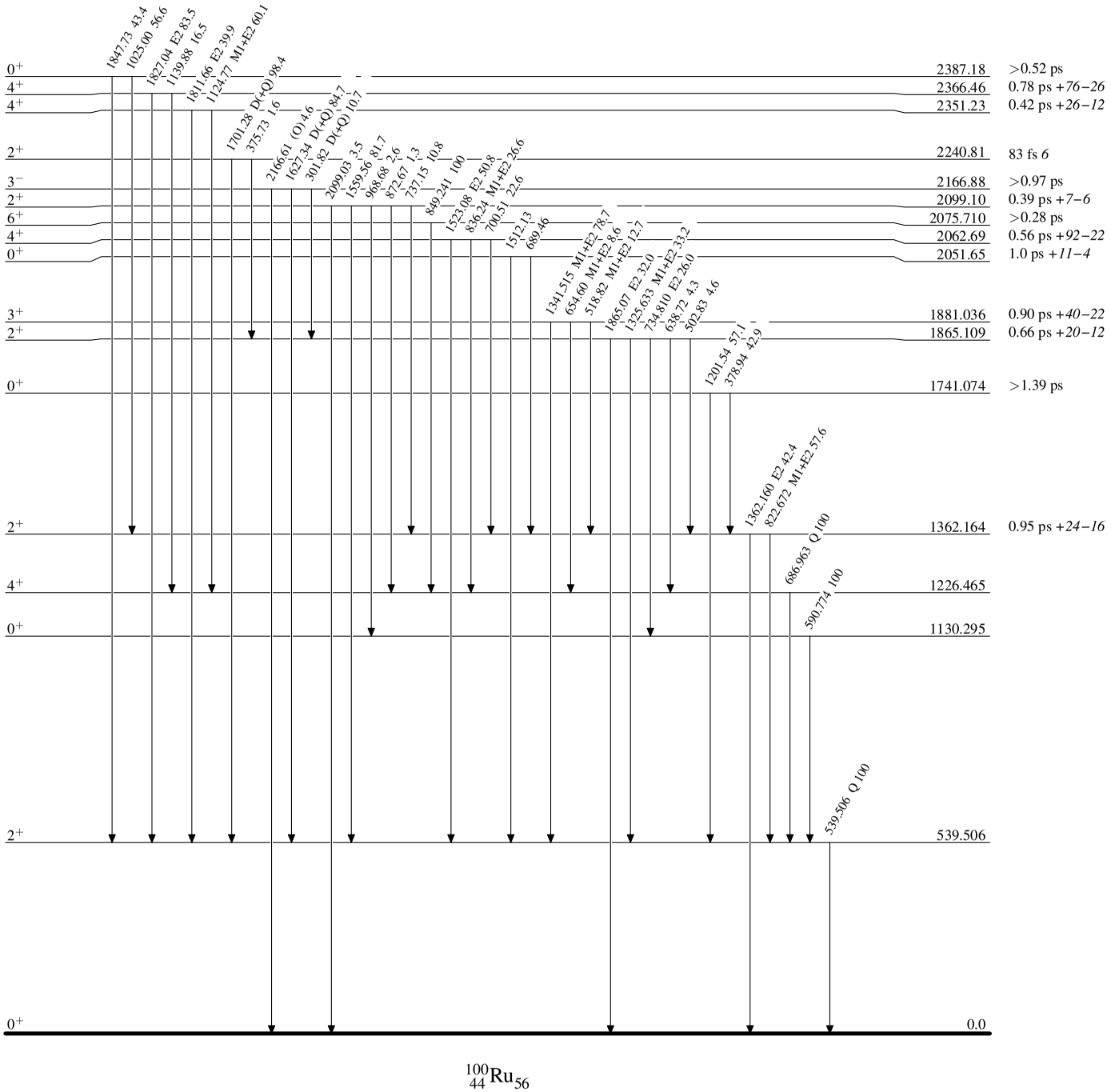


$^{100}_{44}Ru_{56}$

^{100}Ru(n,n′γ),(n,n′) 2001Ge03

Level Scheme (continued)

Intensities: % photon branching from each level



$^{100}_{44}Ru_{56}$