^{93}Nb(p,nγ), (p,n) 1999Ka60,1983Mi13,1976Ru03

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

Others: 1963An01, 1968Fi01, 1970Ki01, 1975Ch05, 1975Gu04, 1976Du01.

1999Ka60: E(p)=2.7-4.3 MeV; 0.55 mg/εM^2 target; coaxial HPGe detector with graded filter to suppress x-rays and very low energy γ-rays; measured Eγ, Iγ, $\gamma(\theta)$ (6 angles, 0° to 90°), excit (55°, 5 energies from 2.7 MeV to 4.3 MeV); lifetimes using DSAM.

1983Mi13: E=3 MeV to 5 MeV, Ge(Li) γ detectors, NE213 n detector; measured Eγ, branching, excit.

1976Du01: 3.5 MeV; measured $T_{1/2}$ using DSAM.

1976Ru03: E=3.7 MeV and 4.4 MeV, Ge(Li) anti-Compton spectrometer; measured Eγ, branching, $\gamma\gamma$ coin, $\gamma(\theta)$ at 10 angles for E(p)=4.4 MeV, $T_{1/2}$ from DSAM.

1975Ch05: E=2.9-4.0 MeV; measured Eγ, $T_{1/2}$ from DSAM.

1975Gu04: E=7MeV, 10 MeV, and 14 MeV, Ge(Li) detectors, magnetic spectrometer; measured Eγ, Iγ, I_{ce}, $\gamma\gamma$ coin, γ(t).

1970Ki01: E=4 MeV to 5.4 MeV, time-of-flight neutron spectroscopy, target thickness≈10 keV for 5-MeV protons; measured n spectra above and below cluster of ^{94}Mo IAS; deduced J$^\pi$ from Hauser-Feshbach statistical analysis of n yields on and off analog resonances.

1968Fi01: E=4.6 MeV to 5.3 MeV, time-of-flight neutron spectroscopy, target≈12 keV thick for 5-MeV protons, θ(lab)=0°, 30°, 55°, 85°, 110° and 135°; n spectra measured above, below and on the 6$^+$, 7$^+$, 5$^+$ and (3$^+$ + 4$^+$) analog resonances in ^{94}Mo near E(p)=4.8 MeV.

^{93}Mo Levels

E(level) values from 1968Fi01 (ΔE=5-10 keV) agree within uncertainties with at least one E(level) reported in (p,nγ), except for the E=2882 8, 2957 5, 3006 5 and 3084 5 levels or groups of levels from 1968Fi01. E(level) values from 1970Ki01 (ΔE=4 keV) are typically 10-15 keV higher than those from 1968Fi01 for E>2200, but the two studies probably observe the same levels for E≤2880 keV; for E>2880, 1968Fi01 and 1970Ki01 report seven and five n groups, respectively.

E(level)[†]	J$^\pi$[‡]	$T_{1/2}$[#]	L	Comments
0	5/2$^+$			J$^\pi$: adopted value.
943.28 7	1/2$^+$	0.42 ps +111−2	4	$T_{1/2}$: from 1976Du01. Others: >0.8 ps (1976Ru03), >0.69 (1999Ka60).
1363.19 4	7/2$^+$	104 fs +8−6		$T_{1/2}$: others: 83 fs +12−10 (1999Ka60), 104 fs +35−21 (1976Du01), 80 +42−31 (1975Ch05).
1477.33 5	9/2$^+$	0.27 ps 9		$T_{1/2}$: weighted average of 0.32 ps +19−9 (1976Du01, Doppler effect) and 0.24 ps +13−9 (1975Ch05). Others: 0.8 ps +6−3 (1976Ru03), 0.66 ps +10−14 (1999Ka60).
1492.49 6	3/2$^+$	13.9 fs 21		$T_{1/2}$: others: 17 fs +12−10 (1999Ka60), 26 fs +8−6 (1976Du01), 26 fs +14−9 (1975Ch05).
1520.44 5	7/2$^+$	0.8 ps 3		$T_{1/2}$: weighted average of 1.0 ps +6−3 (1976Ru03) and 0.62 ps +55−17 (1976Du01). Other: >0.83 ps (1999Ka60), >0.19 ps (1975Ch05).
1695.09 6	5/2$^+$	73 fs +10−7		$T_{1/2}$: others: 73 fs 6 (1999Ka60), 80 fs +28−14 (1976Du01), 66 fs +35−17 (1975Ch05).
2142.06 7	5/2$^+$	0.121 ps +76−24		$T_{1/2}$: others: 152 fs +55−33 (1999Ka60), 0.14 +7−5 (1975Ch05).
2162.04 7	13/2$^+$	>1.6 ps		$T_{1/2}$: other: >0.69 ps (1999Ka60).
2181.11 21	1/2$^+$,3/2$^+$	37 fs +15−10		$T_{1/2}$: other: 38 fs +17−12 (1999Ka60).
2247.26 6	9/2$^+$,11/2$^+$	0.28 ps +9−6		$T_{1/2}$: 0.26 ps +13−7 (1999Ka60), other: >0.27 ps (1975Ch05).
2304.30 7	11/2$^-$	0.36 ps +8−6		$T_{1/2}$: others: 319 fs +42−31 (1999Ka60), >0.20 ps (1975Ch05).
2356.15 6	5/2$^-$	0.32 ps +13−8		$T_{1/2}$: others: 333 fs 67−19 (1999Ka60), >0.35 ps (1975Ch05).
2398.22 10	5/2$^+$	21 fs 3		$T_{1/2}$: other: 18.0 fs +49−35 (1999Ka60).
2409.25 7	9/2$^+$	0.47 ps +10−6		$T_{1/2}$: others: 478 fs +73−52 (1999Ka60), >0.62 ps (1975Ch05).
2425.2[@] 10	21/2$^+$			J$^\pi$: adopted value.
2429.94 9	17/2$^+$	3.53[&] ns 18		$T_{1/2}$: other: >0.83 ps (1999Ka60).
2431.01 8	7/2$^-$	0.121 ps +17−14		adopted π=+.

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^{93}Nb(p,nγ), (p,n) 1999Ka60,1983Mi13,1976Ru03 (continued)

^{93}Mo Levels (continued)

E(level)[†]	J^{π}[‡]	$T_{1/2}$[#]	Comments
			$T_{1/2}$: 118 fs +*35*−*21* (1999Ka60), Other: 0.11 +*6*−*4* (1975Ch05).
2440.55 *7*	$(11/2^-)$	0.41 ps +*15*−*0*	$T_{1/2}$: >0.31 ps (1975Ch05), 0.26 ps +*30*−*10*, >0.41 ps (1976Ru03), 0.27 ps +*8*−*5* (1999Ka60),
2440.71 *7*	$9/2^-$	>0.83 ps	$T_{1/2}$: from 1999Ka60.
2450.26 *7*	$(13/2^-)$	0.76[&] ns *4*	$T_{1/2}$: other: >0.83 ps (1999Ka60).
2479.15 *6*	$7/2^+$	34 fs +*4*−*3*	$T_{1/2}$: 39 fs +*6*−*3* (1999Ka60), Other: 60 fs +*35*−*21* (1975Ch05).
2535.00 *8*	$9/2^+$	69 fs +*10*−*4*	$T_{1/2}$: 67 fs +*10*−*7* (1999Ka60), Other: 90 fs +*42*−*24* (1975Ch05).
2539.5 *5*	$3/2^-$	61 fs +*8*−*7*	J^{π}: adopted value is (3/2); π could not Be assigned there because of contradictory data. $T_{1/2}$: from 1999Ka60.
2573.06 *9*	$15/2^-$	<0.4[&] ns	$T_{1/2}$: others: >0.83 ps (1999Ka60), >0.18 ps (1976Ru03).
2641.99 *10*	$15/2^+$	0.20 ps +*4*−*3*	$T_{1/2}$: from 1999Ka60. Others: >0.18 ps (1976Ru03), <0.4 ns (1975Gu04).
2644.57 *17*	$(3/2^-)$	0.09 ps +*6*−*3*	
2668.08 *8*	$13/2^+$	>0.69 ps	$T_{1/2}$: from 1999Ka60. other: >0.30 ps (1976Ru03).
2670.1 *4*	1/2	22 fs +*8*−*6*	
2698.0 *3*	$3/2^+$	37 fs +*28*−*15*	J^{π}: note that adopted π=−.
2719.40 *13*	$5/2^-$	44 fs +*8*−*6*	
2730.75 *14*	$9/2^+$	114 fs +*21*−*17*	
2742.7 *8*	1/2	0.14 ps +*17*−*5*	
2755.42 *8*	$11/2^-$	>0.54 ps	
2769.15 *14*	$5/2^+$	37 fs +*5*−*4*	
2810.34 *10*	$13/2^-$	<0.4[&] ns	
2821.24 *9*	$9/2^+$	58 fs +*10*−*9*	
2831.41 *16*	$3/2^+$	0.08 ps +*10*−*4*	
2832.70 *10*	$7/2^+$		
2833.65 *8*	$9/2^-$	0.14 ps +*22*−*5*	
2834.6 *3*	$11/2^+$		
2840.29 *9*	$7/2^-$	0.100 ps +*24*−*17*	
2851.93 *10*	$5/2^-$	0.13 ps +*140*−*6*	
2861.5 *5*	$1/2^-,3/2^-$		
2862.90 *22*	$13/2^+$		
2882[a] *8*			
2902.26 *8*	$9/2^+$	40 fs +*7*−*3*	
2915.64 *8*	$11/2^+$	0.18 ps +*13*−*5*	
2957[a] *5*			
2974.09 *12*	$7/2^-$	128 fs +*38*−*24*	
2974.36 *22*			
3006[a] *5*			
3024.48 *25*			
3046.43 *22*	$11/2^+$		
3048.35 *10*	$9/2^-$	>38 fs	
3057.28 *19*	$15/2^+$		
3068.99 *13*	$13/2^+$	>0.125 ps	
3084[a] *5*			
3101.11 *12*	$9/2^-$		
3118.76 *22*	$13/2^-$		
3142.65 *21*	$11/2^+$		
3151.6 *5*	$3/2^-$[c]		
3161.3 *10*	$7/2^-$[c]		
3178.25 *21*	$11/2^-$		
3199.81 *21*	$7/2^-$		
3210.6 *3*	[b]		
3221.1 *20*	$3/2^-$		
3241.70 *18*	$13/2^-$		

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^{93}Nb(p,nγ), (p,n) 1999Ka60,1983Mi13,1976Ru03 (continued)

^{93}Mo Levels (continued)

E(level)[†]	J$^\pi$[‡]	E(level)[†]	J$^\pi$[‡]	E(level)[†]	J$^\pi$[‡]
3299.1 *20*	3/2$^-$	3395.1 *20*	7/2$^-$	3444 *3*	7/2$^-$
3348.2 *4*	9/2$^-$	3406.2 *5*	5/2$^-$[c]	3486.31 *23*	13/2$^-$
3379.3 *3*	11/2$^-$	3436 *3*	5/2$^-$[c]	10.76×10^3[d] *15*	

[†] From least-squares fit to Eγ.
[‡] From 1983Mi13; based on comparison of measured n-decay probabilities (deduced from Iγ balance at level) from 6$^+$, 3$^+$, 4$^+$, 7$^+$ and 5$^+$ IAS (in ^{94}Mo) with statistical theory, and on the shape of n excitation functions across the five IAS.
[#] From 1976Ru03 (DSA), if not indicated otherwise.
[@] From E(p)=10 MeV data of 1975Gu04 only.
[&] From 1975Gu04, delayed coincidences.
[a] From (p,n) study of 1968Fi01; may not be a single level.
[b] 1983Mi13 assign 11/2$^-$, but this would imply M2 multipolarity for the 378γ; such a transition could not compete with the (weaker) ΔJ=(0) 455γ branch. The level is excited via the 6$^+$ IAS and its relative decay probability is similar to that observed for 9/2$^-$ levels, so the evaluator does not adopt the 11/2$^-$ assignment from 1983Mi13. Alternatively, the assignment of 7/2$^+$ for the 2833 level May Be incorrect.
[c] Based only on shape of excitation function of n yield in the vicinity of the five IAS in ^{94}Mo near E(p)=4.8 MeV (1983Mi13).
[d] From Q=11.95 MeV *15* (1963An01); ^{93}Nb(g.s.) analog.

γ(^{93}Mo)

α(K)exp data are from 1975Gu04. Since the observed α(K)exp(123)/α(K)exp(268)=1.7 *5* is only consistent with mult.(123γ)=E1 and mult.(268γ)=E2, the authors normalized their data using the average of the normalization factors deduced assuming mult.=E1 and E2 for the 123 and 268 transitions, respectively. This procedure leads to α(K)exp(203)=0.010 *3* cf. α(K)=0.0143 for mult.=E1; if the data were renormalized to increase α(K)exp(203) to E1-theory value, multipolarity deduced for 203, 237 and 268 transitions would not change, but α(K)exp for 123 and 212 transitions would fall midway between E1 and M1 theory values. Evaluator concludes that data can only determine mult.=D for 123 and 212 transitions, even though authors′ normalization procedure favors E1 for both. α(K)exp(123) may also have been underestimated due to an overestimation of I(123γ) in 1975Gu04; I(411γ)/I(123γ)=29 *2* from 1983Mi13 and 1976Ru03, 17 *5* from 1975Gu04.

Coin information is from 1976Ru03 and 1975Gu04.

E_i(level)	J^π_i	E_γ[‡]	I_γ[#]	E_f	J^π_f	Mult.[@]	δ[@]	Comments
943.28	1/2+	943.27[c] *7*	100[c]	0	5/2+			
1363.19	7/2+	1363.16[c] *7*	100[c]	0	5/2+	D(+Q)	+0.5 *+9−7*	Mult.,δ: A_2=−0.03 *1*, A_4=−0.01 *1* (1999Ka60).
1477.33	9/2+	114.27[c] *12*	0.906[c] *15*	1363.19	7/2+	D+Q	−0.05 *+3−2*	Mult.,δ: A_2=+0.02 *2*, A_4=+0.01 *2* (1999Ka60).
		1477.33[c] *7*	100.0[c] *4*	0	5/2+	Q		Mult.: A_2=+0.25 *1*, A_4=−0.04 *1* (1999Ka60).
1492.49	3/2+	1492.43[c] *8*	100[c]	0	5/2+	D		Mult.: A_2=+0.06 *1*, A_4=+0.04 *2* (1999Ka60).
1520.44	7/2+	1520.39[c] *7*	100[c]	0	5/2+	D+Q	−1.2 *+3−5*	Mult.,δ: A_2=+0.34 *5*, A_4=+0.03 *5* (1999Ka60).
1695.09	5/2+	202.9[e] *1*	13.4 *5*	1492.49	3/2+			E_γ,I_γ: from 1976Ru03; shown As uncertain because γ should have been observed by other authors, but was not.
		331.90[c] *8*	8.5 *10*	1363.19	7/2+	D		I_γ: weighted average of 8.3 *9* (1976Ru03), 7.4 *8* (1983Mi13), 11.0 *11* (1999Ka60). Mult.: A_2=+0.05 *20*, A_4=+0.04 *2* (1999Ka60).
		1695.10[c] *12*	100.0[c] *7*	0	5/2+	D		Mult.: A_2=+0.08 *4*, A_4=0.00 *5* (1999Ka60).
2142.06	5/2+	778.80[c] *9*	17.9[c] *5*	1363.19	7/2+	D+Q		Mult.,δ: A_2=+0.07 *2*, A_4=+0.05 *3*(1999Ka60). δ=+9.7 *2* or +0.04 *+1−2*.
		2142.09[c] *9*	100.0[c] *24*	0	5/2+			
2162.04	13/2+	684.66[c] *7*	100[c]	1477.33	9/2+	Q+O	+0.12 *2*	Mult.: A_2=−0.32 *1*, A_4=+0.05 *1* (1999Ka60). δ: weighted average of +0.11 *+1−3* (1976Ru03) and +0.15 *+2−4* (1999Ka60). both values violate RUL.
2181.11	1/2+,3/2+	2181.08[c] *21*	100[c]	0	5/2+	D		Mult.,δ: A_2=+0.04 *1*, A_4=+0.05 *1* (1999Ka60).
2247.26	9/2+,11/2+	769.92[c] *8*	100.0[c] *10*	1477.33	9/2+	D+Q	+0.113 *26*	Mult.: A_2=−0.34 *3*, A_4=+0.08 *4* (1999Ka60). δ: weighted average of +0.15 *+5−3* (1976Ru03, if J=11/2), +0.10 *+3−2* (1999Ka60).
		884.03[c] *8*	3.0 *4*	1363.19	7/2+			I_γ: unweighted average of 2.25 *20* (1976Ru03), 3.4 *5* (1983Mi13), 3.2 *4* (1999Ka60).
2304.30	11/2−	827.02[c] *8*	100[c]	1477.33	9/2+	D+Q	+0.27 *+13−10*	Mult.,δ: A_2=−0.02 *3*, A_4=0.0 *3* (1999Ka60). δ: weighted average of +0.36 *+19−15* (1976Ru03) and +0.20 *+17−12* (1999Ka60); violates RUL if mult=E1+M2.
2356.15	5/2−	835.65[c] *8*	100.0[c] *22*	1520.44	7/2+	D+Q	−0.05 *+3−2*	Mult.,δ: A_2=+0.12 *2*, A_4=+0.01 *2* (1999Ka60).
		863.65[c] *8*	28.7[c] *19*	1492.49	3/2+			

γ(^{93}Mo) (continued)

E_i(level)	J_i^π	E_γ[‡]	I_γ[#]	E_f	J_f^π	Mult.[@]	δ[@]	α[†]	Comments
2356.15	5/2⁻	2356.18[c] *8*	67 *3*	0	5/2⁺				I_γ: weighted average of 74 *3* (1976Ru03), 78 *5* (1983Mi13), 64.8 *14* (1999Ka60).
2398.22	5/2⁺	905.67 *10*	17.8 *24*	1492.49	3/2⁺	D			E_γ,I_γ: weighted average from 1976Ru03 and 1999Ka60. Mult.,δ: A_2=0.0 *3*, A_4=0.0 *4* (1999Ka60).
		2398.28[c] *17*	100 *3*	0	5/2⁺	D			I_γ: weighted average from 1976Ru03 and 1999Ka60. Mult.,δ: A_2=+0.06 *3*, A_4=+0.01 *3* (1999Ka60).
2409.25	9/2⁺	161.86[c] *13*	8.7[c] *10*	2247.26	9/2⁺,11/2⁺	D			I_γ: unweighted average of 6.9 *9* (1983Mi13), 9.0 *6* (1999Ka60), 10.2 *10* (1976Ru03). Mult.,δ: A_2=+0.02 *2*, A_4=+0.01 *2* (1999Ka60).
		931.97[c] *8*	79[c] *3*	1477.33	9/2⁺	D			I_γ: weighted average of 79 *5* from 1983Mi13 and 79 *4* (1999Ka60). Other Iγ: 57.3 *17* (1976Ru03). Mult.,δ: A_2=+0.08 *4*, A_4=+0.01 *4* (1999Ka60).
		2409.20[c] *12*	100.0[c] *21*	0	5/2⁺	Q			I_γ: weighted average from 1983Mi13 and 1999Ka60. Mult.: A_2=+0.24 *1*, A_4=−0.03 *1* (1999Ka60).
2425.2	21/2⁺	263.2[&] *10*	100	2162.04	13/2⁺				
2429.94	17/2⁺	267.93[c] *8*	100[c]	2162.04	13/2⁺	E2		0.0356	α(K)=0.0307 *5*; α(L)=0.00404 *6*; α(M)=0.000724 *11*; α(N+..)=0.0001119 *16* α(N)=0.0001070 *15*; α(O)=4.94×10^{-6} *7* α(K)exp=0.033 *10* Mult.: from α(K)exp. A_2=+0.19 *1*, A_4=0.00 *1* (1999Ka60). δ(Q,O)=+0.02 *5* (1976Ru03) from γ(θ).
2431.01	7/2⁻	1067.81[c] *17*	2.73[c] *18*	1363.19	7/2⁺	D(+Q)	+0.03 *1*		Mult.,δ: A_2=−0.04 *1*, A_4=+0.01 *1* (1999Ka60). δ=+0.03 *1* or −1.2 *1*; second solution would violate RUL if Δπ=yes.
		2431.00[c] *12*	100.0[c] *4*	0	5/2⁺	D+Q	−6.5 *+14−11*		Mult.,δ: A_2=−0.06 *1*, A_4=0.00 *2* (1999Ka60). However, δ is far too large for a Δπ=yes transition; adopted Δπ=No.
2440.55	(11/2⁻)	136.23[c] *12*	0.20 *4*	2304.30	11/2⁻				I_γ: from 1999Ka60. other Iγ:1.22 *10* from 1983Mi13.
		278.50[c] *14*	0.30 *12*	2162.04	13/2⁺				I_γ: from 1999Ka60. other Iγ: 0.82 *10* from 1983Mi13.
		963.18[c] *8*	100.0 *10*	1477.33	9/2⁺				
2440.71	9/2⁻	920.28[c] *8*	29.8 *11*	1520.44	7/2⁺				I_γ: weighted average from 1983Mi13 and 1976Ru03. other: 4.29 *21* (1976Ru03; however, spectra suggest a much larger value).
		1077.50[c] *8*	100.0 *14*	1363.19	7/2⁺	D(+Q)	−0.05 *11*		I_γ: weighted average from 1983Mi13 and 1999Ka60. Mult.,δ: A_2=−0.02 *1*, A_4=+0.01 *1* (1999Ka60). δ=+10.70 *12* or −0.05 *11*; first solution far too large for a Δπ=yes transition.
2450.26	(13/2⁻)	(9.73[d] *12*)	8.5	2440.55	(11/2⁻)	[M1]		29.5 *12*	α(L)=24.4 *10*; α(M)=4.38 *18*; α(N+..)=0.70 *3* α(N)=0.66 *3*; α(O)=0.0355 *15*

$^{93}_{42}$Mo$_{51}$-5

γ(^{93}Mo) (continued)

E_i(level)	J_i^π	E_γ[‡]	I_γ[#]	E_f	J_f^π	Mult.[@]	δ[@]	α[†]	Comments
									E_γ: not observed; E from level energy difference. I_γ: from B(M1)(W.u.)=0.7 (1983Mi13) and $T_{1/2}$=0.76 ns *4*, Ti(9.7)=70.6%.
2450.26	(13/2$^-$)	146.00[c] *12*	5.8[c] *4*	2304.30	11/2$^-$	[M1]		0.0887	α(K)=0.0777 *11*; α(L)=0.00914 *13*; α(M)=0.001637 *24*; α(N+..)=0.000262 *4* α(N)=0.000248 *4*; α(O)=1.381×10^{-5} *20*
		202.98[c] *8*	100.0[c] *11*	2247.26	9/2$^+$,11/2$^+$	E1		0.01630	α(K)=0.01434 *21*; α(L)=0.001627 *23*; α(M)=0.000289 *4*; α(N+..)=4.59×10^{-5} *7* α(N)=4.36×10^{-5} *7*; α(O)=2.33×10^{-6} *4* α(K)exp=0.010 *3* Mult.: from α(K)exp. A_2=−0.04 *2*, A_4=0.00 *2* (1999Ka60) from γ(θ).
		288.30[c] *17*	3.70[c] *21*	2162.04	13/2$^+$				
2479.15	7/2$^+$	1001.80[c] *8*	72 *4*	1477.33	9/2$^+$				I_γ: weighted average from 1983Mi13 and 1999Ka60. Other Iγ: 109 *8* (1976Ru03).
		1115.95[c] *8*	100 *5*	1363.19	7/2$^+$	D(+Q)			Mult.,δ: A_2=+0.02 *2*, A_4=+0.02 *2* (1999Ka60). δ=+0.04 *4* or −0.98 *11*. I_γ: weighted average from 1983Mi13 and 1999Ka60.
		2479.17[c] *13*	14.8 *22*	0	5/2$^+$				I_γ: from 1999Ka60. Other Iγ: 30 *4* (1983Mi13), 39.6 *25* (1976Ru03).
2535.00	9/2$^+$	287.78[c] *9*	24.3[c] *13*	2247.26	9/2$^+$,11/2$^+$				
		1057.61[c] *14*	100.0[c] *25*	1477.33	9/2$^+$	D			Mult.: A_2=+0.04 *2*, A_4=+0.01 *3* (1999Ka60).
		1171.84[c] *17*	22.1[c] *9*	1363.19	7/2$^+$				
		2534.88[c] *15*	37.7[c] *17*	0	5/2$^+$				
2539.5	3/2$^-$	1047.0 *5*	100	1492.49	3/2$^+$	D+Q	−1.28 *+14−15*		E_γ,I_γ: from 1999Ka60. γ not reported by 1983Mi13 or 1976Ru03. Mult.,δ: A_2=+0.24 *3*, A_4=+0.01 *4* (1999Ka60). note that 1999Ka60 indicate a 3/2$^-$ to 3/2$^+$ transition but their δ=−1.28 *+14−15* implies a B(M2)(W.u.) value which would grossly exceed RUL.
2573.06	15/2$^-$	122.87[c] *12*	100.0[c] *13*	2450.26	(13/2$^-$)	D			α(K)exp=0.056 *17* Mult.: from α(K)exp; see also the general comment on α(K)exp data of 1975Gu04. α(K)exp: based on I(123γ) from 1975Gu04; α(K)exp=0.097 *29*, consistent with M1 theory, based on I(411γ) from 1975Gu04 and adopted I(411γ)/I(123γ)=0.289 *13*.
		143.19 *19*	0.52 *14*	2429.94	17/2$^+$				E_γ: weighted average from 1983Mi13 and 1999Ka60. I_γ: from 1999Ka60. other Iγ: 3.4 *5* from 1983Mi13.
		410.94[c] *9*	28.9[c] *13*	2162.04	13/2$^+$	D			
2641.99	15/2$^+$	212.09[c] *9*	39.5[c] *15*	2429.94	17/2$^+$	D			α(K)exp=0.013 *4* Mult.: from α(K)exp; see general comment on α(K)exp data of 1975Gu04 also. α(K)exp: relative

$^{93}_{42}$Mo$_{51}$-6

γ(^{93}Mo) (continued)

E_i(level)	J^π_i	E_γ[‡]	I_γ[#]	E_f	J^π_f	Mult.[@]	α[†]	Comments
								to α(K)exp(203)=0.010 *3*. A_2=+0.04 *1*, A_4=+0.03 *1* from $\gamma(\theta)$ (1999Ka60). δ(D,Q)=0.00 *5* from $\gamma(\theta)$ (1976Ru03).
2641.99	15/2⁺	479.92[c] *9*	100.0[c] *23*	2162.04	13/2⁺	D		Mult.: A_2=−0.21 *4*, A_4=+0.05 *5* (1999Ka60). δ(D,Q)=+0.02 *5* (1976Ru03), −0.05 *7* (1999Ka60).
2644.57	(3/2⁻)	2644.53 *17*	100	0	5/2⁺			
2668.08	13/2⁺	420.85[c] *8*	36.5[c] *22*	2247.26	9/2⁺,11/2⁺			
		506.00[c] *8*	100[c] *4*	2162.04	13/2⁺			
2670.1	1/2	2670.1 *4*	100	0	5/2⁺			
2698.0	3/2⁺	2698.0 *3*	100	0	5/2⁺			
2719.40	5/2⁻	1024.20 *19*	30.0 *18*	1695.09	5/2⁺			
		2719.44 *17*	100.0 *24*	0	5/2⁺			
2730.75	9/2⁺	1035.60 *21*	5.6[b] *5*	1695.09	5/2⁺			I_γ: from 1983Mi13. other I_γ: 18.9 *18* in 1976Ru03 (table I) but γ omitted from level diagram; spectrum shows impurity nearby.
		2730.74 *17*	100.0[b] *5*	0	5/2⁺			
2742.7	1/2	2742.7 *8*	100	0	5/2⁺			
2755.42	11/2⁻	451.10 *9*	100.0 *12*	2304.30	11/2⁻			
		1278.10 *10*	13.6 *7*	1477.33	9/2⁺			
2769.15	5/2⁺	1406.15 *21*	64 *7*	1363.19	7/2⁺			
		2768.97 *17*	100 *3*	0	5/2⁺			
2810.34	13/2⁻	237.20 *14*	100.0 *15*	2573.06	15/2⁻	M1	0.0246	α(K)=0.0215 *3*; α(L)=0.00250 *4*; α(M)=0.000447 *7*; α(N+..)=7.17×10^{-5} *11* α(N)=6.79×10^{-5} *10*; α(O)=3.81×10^{-6} *6* α(K)exp=0.018 *5* Mult.: from α(K)exp.
		369.82 *9*	61.6 *18*	2440.55	(11/2⁻)			
2821.24	9/2⁺	1343.90 *9*	95 *5*	1477.33	9/2⁺			
		1458.01 *17*	100 *3*	1363.19	7/2⁺			
2831.41	3/2⁺	433.13 *17*	30 *3*	2398.22	5/2⁺			
		1136.45 *25*	100 *6*	1695.09	5/2⁺			
2832.70	7/2⁺	1312.20 *10*	100[a] *4*	1520.44	7/2⁺			
		1355.67 *24*	63[a] *7*	1477.33	9/2⁺			
2833.65	9/2⁻	393.02 *9*	100.0 *22*	2440.55	(11/2⁻)			
		402.68 *9*	42 *3*	2431.01	7/2⁻			
		529.40 *9*	34.4 *22*	2304.30	11/2⁻			
2834.6	11/2⁺	1471.4 *3*	100	1363.19	7/2⁺			
2840.29	7/2⁻	484.2[b] *3*	20.0[b] *25*	2356.15	5/2⁻			
		1145.22 *9*	76[b] *5*	1695.09	5/2⁺			Other branching: 116 *8* (1976Ru03).
		2840.15 *15*	100[b] *6*	0	5/2⁺			
2851.93	5/2⁻	420.9[b] *2*	67[b] *8*	2431.01	7/2⁻			
		495.78 *9*	100[b] *8*	2356.15	5/2⁻			

γ(^{93}Mo) (continued)

E_i(level)	J^π_i	E_γ[‡]	I_γ[#]	E_f	J^π_f	Comments
2861.5	1/2$^-$,3/2$^-$	2861.5 *5*	100	0	5/2$^+$	
2862.90	13/2$^+$	700.86 *21*	100	2162.04	13/2$^+$	E_γ: weighted average of 700.7 *3* (1983Mi13), 700.5 *6* (1976Ru03), 701.1 *3* (1975Gu04).
2902.26	9/2$^+$	1381.75 *14*	71 *9*	1520.44	7/2$^+$	
		1424.90 *17*	28.5 *25*	1477.33	9/2$^+$	
		1539.06 *9*	100 *6*	1363.19	7/2$^+$	
		2903.2 *6*	9.5 *15*	0	5/2$^+$	
2915.64	11/2$^+$	247.55 *14*	30.1 *22*	2668.08	13/2$^+$	
		668.34 *9*	100 *6*	2247.26	9/2$^+$,11/2$^+$	
		753.62 *9*	68 *3*	2162.04	13/2$^+$	
		1438.40 *21*	15.2 *22*	1477.33	9/2$^+$	
2974.09	7/2$^-$	543.0[b] *2*	33[b] *4*	2431.01	7/2$^-$	
		1453.78 *18*	43 *4*	1520.44	7/2$^+$	
		2973.94 *19*	100 *3*	0	5/2$^+$	
2974.36		1611.15 *21*	100	1363.19	7/2$^+$	
3024.48		1547.2 *3*	100 *6*	1477.33	9/2$^+$	
		1661.9[ae] *3*	128[a]	1363.19	7/2$^+$	Placed by 1976Ru03 from 3024 level in table I but not in fig. 5, and attributed to (p,γ) in fig. 1; not adopted.
		3024.3 *4*	41 *4*	0	5/2$^+$	
3046.43	11/2$^+$	1526.0[b] *3*	44[b] *7*	1520.44	7/2$^+$	
		1683.2[b] *3*	100[b] *7*	1363.19	7/2$^+$	
3048.35	9/2$^-$	292.9[b] *2*	8.8[b] *12*	2755.42	11/2$^-$	
		607.64 *9*	100.0[b] *12*	2440.71	9/2$^-$	
3057.28	15/2$^+$	627.34 *17*	100 *15*	2429.94	17/2$^+$	Branching is from 1975Gu04; Eγ is weighted average from 1975Gu04 and 1983Mi13.
		895.3[&] *10*	41 *12*	2162.04	13/2$^+$	Branching from 1975Gu04; γ present in spectrum but not placed in 1983Mi13.
3068.99	13/2$^+$	427.00 *9*	100[a] *11*	2641.99	15/2$^+$	
		1576.9[ae] *4*	47[a] *12*	1492.49	3/2$^+$	Placed by 1976Ru03 from 3069 level in table I but not in fig. 5, and γ absent in spectra of figs. 1 and 2; not adopted.
3101.11	9/2$^-$	345.8[b] *2*	59[b] *5*	2755.42	11/2$^-$	
		796.9[b] *3*	32[b] *3*	2304.30	11/2$^-$	
		1623.7[b] *2*	100[b] *6*	1477.33	9/2$^+$	
		1737.8[b] *2*	74[b] *5*	1363.19	7/2$^+$	
3118.76	13/2$^-$	668.5[b] *2*	[b]	2450.26	(13/2$^-$)	
3142.65	11/2$^+$	733.4[b] *2*	100[b]	2409.25	9/2$^+$	
3151.6	3/2$^-$	2208.3[b] *5*	100[b]	943.28	1/2$^+$	
3161.3	7/2$^-$	3161.2[b] *10*	100[b]	0	5/2$^+$	
3178.25	11/2$^-$	737.7[b] *2*	100[b]	2440.55	(11/2$^-$)	
3199.81	7/2$^-$	759.1[b] *2*	85[b] *6*	2440.71	9/2$^-$	
		3199.8[b] *10*	100[b] *6*	0	5/2$^+$	
3210.6		377.9[b] *3*	100[b] *3*	2832.70	7/2$^+$	

$^{93}_{42}$Mo$_{51}$-8

γ(^{93}Mo) (continued)

E_i(level)	J^π_i	E_γ[‡]	I_γ[#]	E_f	J^π_f
3210.6		455.1[b] 4	25[b] 3	2755.42	11/2⁻
3221.1	3/2⁻	3221[b] 2	100[b]	0	5/2⁺
3241.70	13/2⁻	791.4[b] 3	18.8[b] 20	2450.26	(13/2⁻)
		801.0[b] 2	100.0[b] 23	2440.71	9/2⁻
3299.1	3/2⁻	3299[b] 2	100[b]	0	5/2⁺
3348.2	9/2⁻	592.8[b] 4	100[b]	2755.42	11/2⁻
3379.3	11/2⁻	938.7[b] 4	66[b] 6	2440.55	(11/2⁻)
3379.3	11/2⁻	1075.0[b] 4	100[b] 6	2304.30	11/2⁻
3395.1	7/2⁻	3395[b] 2	100[b]	0	5/2⁺
3406.2	5/2⁻	2462.9[b] 5	100[b]	943.28	1/2⁺
3436	5/2⁻	3436[b] 3	100[b]	0	5/2⁺
3444	7/2⁻	3444[b] 3	100[b]	0	5/2⁺
3486.31	13/2⁻	385.2[b] 2	100[b]	3101.11	9/2⁻

† Additional information 1.

‡ Weighted average from 1983Mi13 and 1976Ru03, if not indicated otherwise.

\# Weighted average branching from 1983Mi13 and 1976Ru03, normalized so Iγ=100 for the strongest γ branch from each level, if not indicated otherwise. For relative Iγ at E(p)=10 MeV, see 1975Gu04.

@ From γ(θ) (1976Ru03), except as noted.

& From 1975Gu04.

a From 1976Ru03.

b From 1983Mi13.

c Weighted average from 1999Ka60, 1983Mi13 and 1976Ru03.

d The neutron yield to the 2440.6 state (as deduced from Iγ balance) is too high for a single level, whereas that to the 2450 state is too low for a level with J as high as indicated by excit for the 203γ deexciting it. 1983Mi13, therefore, conclude that a strong γ transition between these states exists. Assuming that excitation functions for the neutron yield in the vicinity of the isobaric analog resonances are the same for states having the same J^π, 1983Mi13 deduce Ti(9.7γ) from the difference of the excitation functions for the 2440.6 and 2305 levels. 1983Mi13 deduce B(M1)(W.u.)=0.7 for this transition, and demonstrate that its excitation function across the IAS has the same shape as that of 203γ.

e Placement of transition in the level scheme is uncertain.

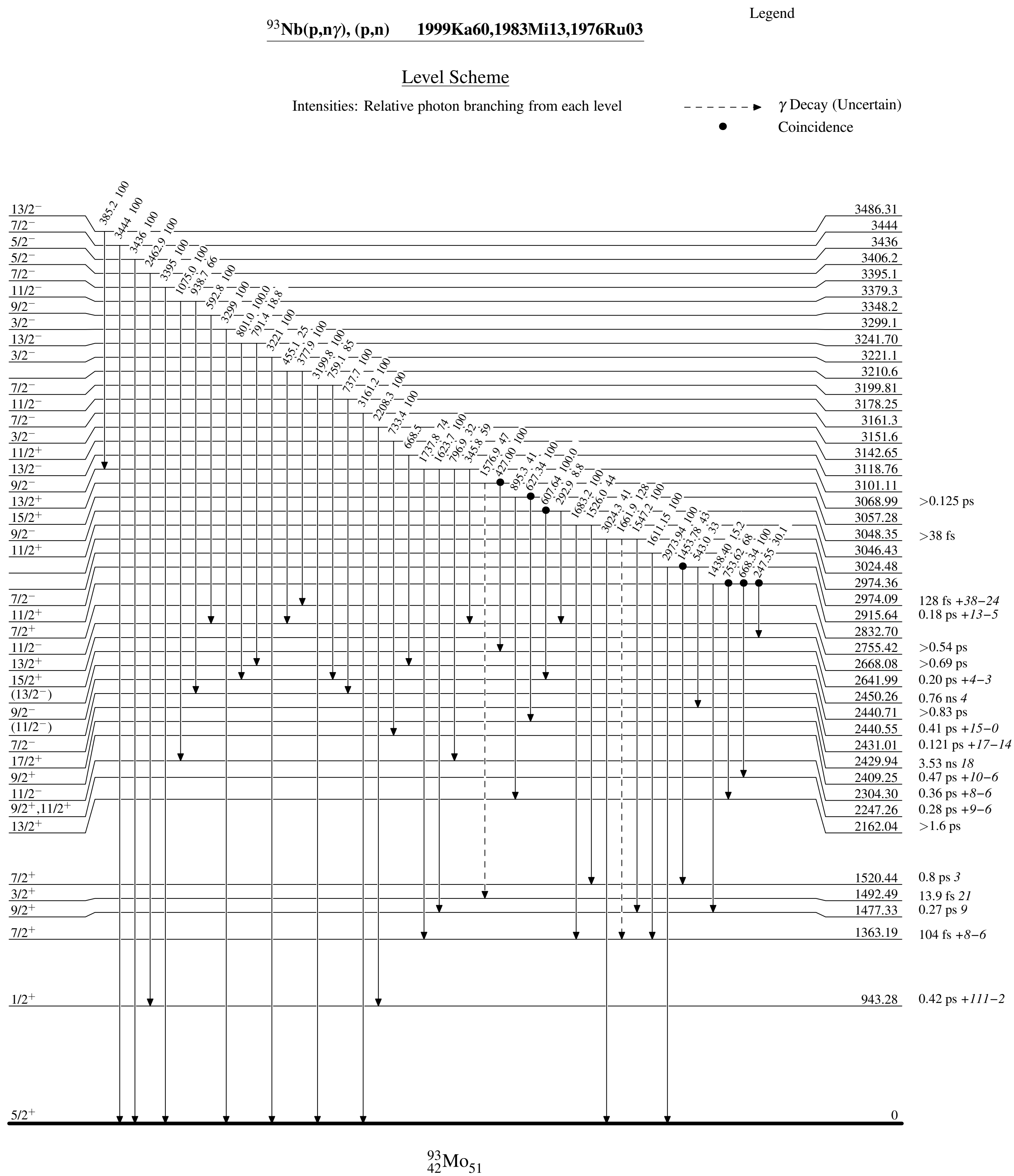
x γ ray not placed in level scheme.

$^{93}_{42}$Mo$_{51}$-9

^{93}Nb(p,nγ), (p,n) 1999Ka60,1983Mi13,1976Ru03

Level Scheme

Intensities: Relative photon branching from each level



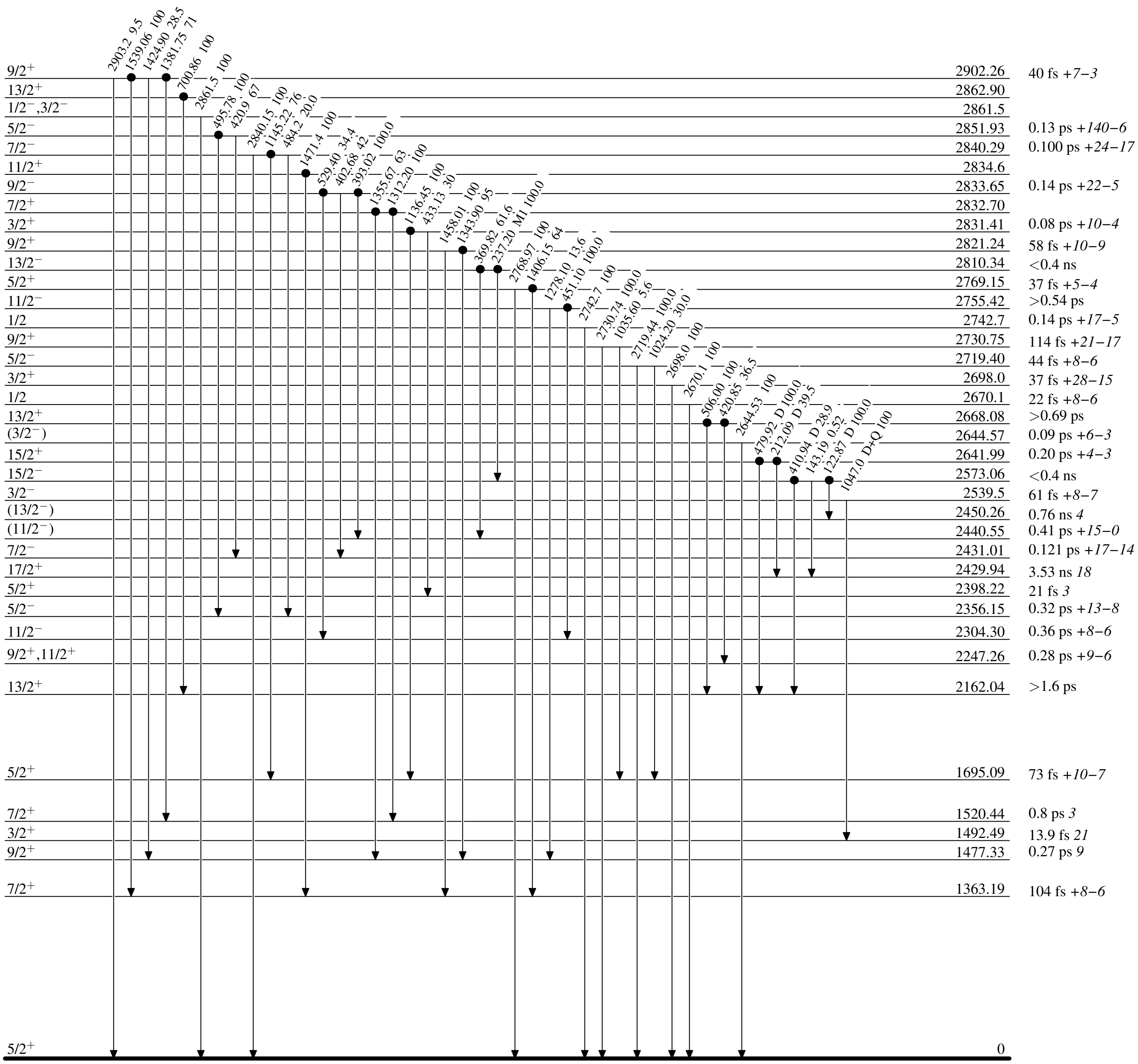
^{93}Nb(p,nγ), (p,n) 1999Ka60,1983Mi13,1976Ru03

Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

● Coincidence



$^{93}_{42}Mo_{51}$

^{93}Nb(p,nγ), (p,n) 1999Ka60,1983Mi13,1976Ru03