^{64}Ni(α,nγ)

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Huo Junde, Huang Xiaolong, J. K. Tuli	NDS 106, 159 (2005)	1-Apr-2005

1978Du04: E(α)=8.2 MeV; Eγ, Iγ, γγ coincidences, γ(θ).
1978Ku05: E(α)=8.9, 11 MeV; $T_{1/2}$ by DSAM.
1978Lo06, 1977Lo03: E(α)=6.5-17.0 MeV; γγ coincidences, γ(θ), γ-linear polarization, $T_{1/2}$ by DSAM.
1977Ne04: E(α)=17-25 MeV; Eγ, Iγ, γγ coincidences, γ(θ).
1975We08: E(α)=7.5, 8.5 MeV; γ(θ).
1974Ni01: E(α) up to 14 MeV; Eγ, Iγ, γ-yield functions, γγ coincidences, γ(θ), γ-linear polarization.
1973Be56: E(α)=13.5 MeV; γ(θ,H,t), $T_{1/2}$.
1981GrZR: E(α)=11.0 MeV; measured α(K)exp with an orange type spectrometer.
Others: 1975Ba07, 1974Ag03.

^{67}Zn Levels

E(level)[†]	J^π[‡]	$T_{1/2}$[#]	Comments
0.0	5/2⁻		
93.30 *4*	1/2⁻		
184.629 *25*	3/2⁻		
393.55 *3*	3/2⁻	>2.4 ps	
604.48 *5*	9/2⁺	333 ns *14*	g=−0.243 *2* (1973Be56) $T_{1/2}$: from 1973Be56.
814.90 *6*	7/2⁻	2.0 ps *+14−7*	J^π: 7/2⁻ from γ(θ) and linear polarization data of 815γ (1978Lo06).
887.71 *4*	5/2⁻	1.6 ps *+8−2*	J^π: 5/2⁻ from γ(θ) and linear polarization data of 494γ, 794γ and 888γ (1978Lo06).
979.85 *5*	5/2⁺	1.5 ps *+6−3*	J^π: 5/2⁺ from γ(θ) and linear polarization data of 586γ, 980γ (1977Lo03).
1142.85 *6*	1/2⁻	0.42[@] ps *12*	J=1/2 from isotropic γ(θ) for 749γ, 958γ and 1143γ (1978Du04) π=− from E2 to 5/2⁻.
1363.61 *6*	5/2⁻	0.18[@] ps *6*	J=5/2 from γ(θ) of 1179γ (1978Lo06); π=− from M1 to 5/2⁻.
1446.12 *10*	3/2⁻	0.5[@] ps *+4−1*	J=3/2, 5/2 from γ(θ) (1978Du04).
1517.19 *18*	9/2⁻		$T_{1/2}$: 0.49 ps *+7−6* (1978Ku05); 0.21 ps *6* (1978Lo06). J^π: 9/2⁻ from γ(θ) and linear polarization of 1517γ (1978Lo06).
1543.44 *11*	3/2⁻	0.19[@] ps *5*	J=3/2 from γ(θ) (1978Du04); π=− from M1 to 5/2⁻.
1603.68 *10*	7/2⁺	0.42[&] ps *+21−7*	J^π: 7/2⁺ from γ(θ) and linear polarization data for 624γ and 999γ (1977Lo03).
1640.09 *17*	13/2⁺	0.83 ps *+4−3*	J^π: 13/2⁺ from γ(θ) and linear polarization data for 1036γ (1977Lo03).
1656.76 *11*	7/2⁻		$T_{1/2}$: 0.20 ps *5* (1978Lo06); 0.42 ps *+2−1* (1978Ku05). J=3/2, 7/2 from γ(θ) of 769γ; J=3/2 rejected because of unacceptable M2 strength (1978Lo06); π=− from M1 to 5/2⁻.
1677.15 *9*	1/2⁺	0.15[@] ps *4*	J^π: 1/2 from γ(θ) and linear polarization data of 1284γ and 1584γ; however, J=3/2 cannot be rejected (1978Lo06).
1686.84 *10*	3/2, 5/2	0.24[@] ps *8*	J=3/2, 5/2 from γ(θ) of 1293γ, 1502γ (1978Du04).
1732.64 *15*	11/2⁺	0.48[&] ps *+10−7*	J^π: 11/2⁺ from γ(θ) and linear polarization data of 1128γ (1977Lo03).
1780.37 *16*			
1783.18 *10*	(3/2,5/2)⁺	0.29 ps *+7−6*	J^π: (3/2,5/2)⁺ from γ(θ) and linear polarization data of 803γ (1977Lo03).
1800.52 *11*	7/2⁻	0.12[@] ps *4*	J^π: 7/2⁻ from γ(θ) and linear polarization data of 1800γ (1978Lo06).
1807.91 *14*	9/2⁺	>0.7[&] ps	J^π: 9/2⁺ from γ(θ) and linear polarization data of 828γ and 1203γ (1977Lo03).
1842.84 *18*	3/2⁻	0.17[@] ps *8*	J^π: 3/2⁻ from γ(θ) and linear polarization data of 1450γ (1978Lo06).
1875.51 *13*	5/2⁻	0.13[@] ps *4*	J=5/2 from γ(θ) and linear polarization data of 1061γ 1482γ (1978Lo06); π=− from M1 to 7/2⁻.
2027.20 *13*	7/2⁺	1.2[@] ps *+4−3*	

Continued on next page (footnotes at end of table)

^{64}Ni(α,nγ) (continued)

^{67}Zn Levels (continued)

E(level)[†]	Jπ[‡]	$T_{1/2}$[#]	Comments
2065.37 *13*	3/2,5/2,7/2⁻	2.4[a] ps +*21*−*11*	
2083.33 *18*	1/2⁻,3/2,5/2⁻	30[a] fs *8*	
2092.66 *21*		55[a] fs *21*	
2101.84 *14*		>2[a] ps	
2136.9 *4*	9/2$^{(-)}$	0.9 ps +*12*−*3*	Jπ: 9/2⁻ from γ(θ) and yield function of 1322γ (1974Ni01).
2158.6 *4*		40[a] fs *14*	
2175.31 *20*			
2242.84 *25*	1/2,3/2,5/2⁻	43[a] fs *11*	
2272.9 *3*	3/2⁺,5/2⁺	0.33[a] ps +*14*−*11*	
2408.9 *3*	1/2⁺		
2428.1 *4*			
2434.6 *3*	11/2⁻	0.30 ps +*21*−*8*	Jπ: 11/2⁻ from γ(θ) and yield function of 1620γ (1974Ni01).
2451.81 *20*	13/2⁺	0.8 ps +*6*−*3*	Jπ: 13/2⁺ from γ(θ) and yield function of 719γ (1974Ni01).
2503.51 *21*	11/2⁺	0.38 ps +*10*−*8*	Jπ: 11/2⁺ from γ(θ) and yield function of 864γ (1974Ni01). E(level): from 1974Ni01.
2511.5 *7*			
2554.6 *7*	1/2⁻,3/2⁻		
2599.7 *10*	3/2⁺,5/2⁺		
2732.2 *3*	11/2⁻	0.41 ps +*12*−*8*	Jπ: 11/2⁻ from γ(θ) and yield function of 1215γ (1974Ni01). E(level): from 1974Ni01.
2926.4 *4*	(15/2⁺)		Jπ: 15/2⁺ from γ(θ) and yield function of 1286γ (1974Ni01); 1977Ne04 favors a tentative 17/2⁺.
2937.3 *5*			
3029.8 *3*	(11/2⁺, 15/2⁺)		Jπ: (11/2⁺, 15/2⁺) from γ(θ) and yield functions of 1297γ and 1390γ (1977Ne04).
3065.9 *5*	13/2⁻	0.28 ps *2*	J=13/2 from γ(θ) and yield function of 1549γ (1974Ni01); π=− from E2 to 9/2⁻.
3195.6 *4*			
3473.6 *11*	(11/2⁻, 13/2⁻)		Jπ: (11/2⁻, 13/2⁻) from γ(θ) and yield function of 408γ (1977Ne04).
3487.3 *4*		<40 fs	
3489.9[b] *5*			
3490.7[b] *6*			
3696.7 *6*			
3929.6 *6*			
4220.0 *6*			
4630.0 *8*	(21/2⁺)		Jπ: (21/2⁺) from γ(θ) and yield function of 1704γ (1977Ne04).
4684.2 *7*	(21/2⁻)		Jπ: (21/2⁻) from γ(θ) and yield functions of 464γ and 755γ (1977Ne04).

[†] From a least-squares fit to the Eγ data.
[‡] From Adopted Levels. Supporting arguments from this data set are indicated.
[#] From 1978Ku05, except as noted otherwise.
[@] From 1978Lo06.
[&] From 1977Lo03.
[a] From 1978Du04.
[b] *Jπ* assignment uncertain; see discussion by 1977Ne04.

γ(^{67}Zn)

E_i(level)	J^π_i	E_γ[†]	I_γ[‡]	E_f	J^π_f	Mult.[&]	δ[&]	α[b]	Comments
93.30	1/2⁻	93.30 *5*	100	0.0	5/2⁻	E2		0.873	
184.629	3/2⁻	91	12	93.30	1/2⁻	M1+E2	+0.06 *5*	0.083 *8*	
		184.63 *3*	88	0.0	5/2⁻	M1+E2	0.34 *4*	0.0180 *13*	I_γ: from 1975We08.
393.55	3/2⁻	208.91 *4*	8	184.629	3/2⁻	M1+E2	−0.034 *21*	0.00913 *6*	
		300.24 *5*	75	93.30	1/2⁻	M1+E2	+0.20 *8*		
		393.54 *5*	17	0.0	5/2⁻				δ: −0.17 *8* or −2.4 *3* for M1+E2.
604.48	9/2⁺	604.48 *5*	100	0.0	5/2⁻	M2+E3	<0.54		α(K)exp=2.4×10^{-03} *2* (1981GrZR)
814.90	7/2⁻	421.2[d] *4*	<0.8	393.55	3/2⁻				
		630.28 *10*	9[a] *1*	184.629	3/2⁻	E2			
		814.88 *7*	91[a] *1*	0.0	5/2⁻	M1+E2	+5.5 *5*		δ: unweighted average of +6.0 *7* (1978Lo06) and +5.0 *8* (1978Du04); other: +4.0 +*2*−*5* (1974Ni01).
887.71	5/2⁻	494.10 *6*	25[a] *2*	393.55	3/2⁻	M1+E2	−0.14 *3*		
		703.2 *3*	5[a] *2*	184.629	3/2⁻				δ: −0.09 *28* or +8.0 *18* for (M1+E2).
		794.39 *8*	21[a] *2*	93.30	1/2⁻	E2(+M3)	−0.04 *4*		
		887.67 *7*	49[a] *2*	0.0	5/2⁻	M1+E2	+0.96 *9*		
979.85	5/2⁺	374.9 *4*	3	604.48	9/2⁺	E2+M3	−0.8 *3*	0.015 *5*	
		586.29 *7*	73	393.55	3/2⁻	E1(+M2)	0.00 *1*		
		979.86 *8*	24	0.0	5/2⁻	E1(+M2)	−0.03 *3*		
1142.85	1/2⁻	749.30 *8*	45[a] *2*	393.55	3/2⁻				
		958.20 *10*	46[a] *2*	184.629	3/2⁻				
		1142.85 *12*	9[a] *1*	0.0	5/2⁻	E2			
1363.61	5/2⁻	475.5 *2*	8[a] *1*	887.71	5/2⁻	M1+E2	−0.37 *5*		
		970.03 *10*	37[a] *3*	393.55	3/2⁻	M1+E2	−0.31 *6*		
		1179.10 *15*	27[a] *3*	184.629	3/2⁻	(M1(+E2))	−0.2 *2*		
		1270.0 *5*		93.30	1/2⁻				E_γ: only observed by 1978Du04.
		1363.65 *10*	28[a] *4*	0.0	5/2⁻	M1+E2	+2.0 *5*		
1446.12	3/2⁻	558.3 *2*	9	887.71	5/2⁻				
		1052.0 *5*	3	393.55	3/2⁻				
		1261.7 *2*	<24	184.629	3/2⁻				
		1352.6 *2*	45	93.30	1/2⁻				
		1446.20 *15*	19	0.0	5/2⁻				
1517.19	9/2⁻	702.3 *4*	8[a] *3*	814.90	7/2⁻				
		1517.15 *20*	92[a] *3*	0.0	5/2⁻	E2(+M3)	−0.01 *2*		
1543.44	3/2⁻	1149.8 *2*	5	393.55	3/2⁻				
		1358.7 *2*	35	184.629	3/2⁻				
		1543.51 *15*	60	0.0	5/2⁻	M1+E2	+0.20 *8*		
1603.68	7/2⁺	623.8 *2*	15	979.85	5/2⁺	M1(+E2)	+0.07 +*4*−*10*		
		999.20 *10*	85	604.48	9/2⁺	M1+E2	−0.28 *3*		
1640.09	13/2⁺	1035.8 *2*	100	604.48	9/2⁺	E2(+M3)	−0.02 *2*		
1656.76	7/2⁻	768.92 *15*	43	887.71	5/2⁻	M1(+E2)	0.01 *2*		
		1262.9 *3*	<50	393.55	3/2⁻				

$^{67}_{30}$Zn$_{37}$-3

^{64}Ni(α,nγ) (continued)

γ(^{67}Zn) (continued)

E_i(level)	J^{π}_i	E_{γ}†	I_{γ}‡	E_f	J^{π}_f	Mult.&	δ&	Comments
1656.76	7/2⁻	1472.4 *2*	7	184.629	3/2⁻	E2		
		1657.0 *4*		0.0	5/2⁻			
1677.15	1/2⁺	1283.55 *15*	55	393.55	3/2⁻			
		1492.7 *3*	5	184.629	3/2⁻			
		1583.82 *10*	40	93.30	1/2⁻			
1686.84	3/2, 5/2	1293.24 *10*	38[a] *5*	393.55	3/2⁻			
		1502.0 *3*	26[a] *5*	184.629	3/2⁻			
		1687.6 *4*	36[a] *5*	0.0	5/2⁻			
1732.64	11/2⁺	1128.20 *15*	100	604.48	9/2⁺	M1+E2	+0.80 *15*	
1780.37		892.6[d] *3*	<15	887.71	5/2⁻			
		965.46 *15*	51	814.90	7/2⁻			
		1595.0[d] *3*	34	184.629	3/2⁻			
1783.18	(3/2,5/2)⁺	803.20 *15*	37	979.85	5/2⁺			
		1389.3 *2*	24	393.55	3/2⁻			
		1598.3 *3*	11	184.629	3/2⁻			
		1690.5[c] *2*	<28[c]	93.30	1/2⁻			
1800.52	7/2⁻	912.6 *2*	27[a] *3*	887.71	5/2⁻	(M1(+E2))	0.1 *1*	
		1407.3 *3*	18[a] *3*	393.55	3/2⁻			
		1616.0 *2*	24[a] *3*	184.629	3/2⁻			
		1800.4 *2*	31[a] *3*	0.0	5/2⁻	M1+E2	−0.38 *8*	
1807.91	9/2⁺	828.0 *2*	12	979.85	5/2⁺			
		992.8 *5*	11	814.90	7/2⁻			
		1203.5 *2*	51	604.48	9/2⁺	M1+E2	+3 *+2−1*	
		1808.5[d] *3*	26	0.0	5/2⁻			
1842.84	3/2⁻	700.2 *8*	≈10	1142.85	1/2⁻			
		955.0 *4*	5	887.71	5/2⁻			
		1449.5 *3*	29	393.55	3/2⁻			δ: 0.04 *9* or −3.7 *10* for (M1+E2).
		1658.0 *3*	52	184.629	3/2⁻			
		1749.5 *5*	4	93.30	1/2⁻			
1875.51	5/2⁻	511.2[@] *5*		1363.61	5/2⁻			
		1060.54 *15*	79[a] *2*	814.90	7/2⁻	M1+E2	−0.2 *1*	
		1482.15 *20*	21[a] *2*	393.55	3/2⁻	M1+E2	−0.8 *2*	
		1781.7[d] *5*		93.30	1/2⁻			
2027.20	7/2⁺	1047.3 *2*	40	979.85	5/2⁺	M1+E2	+0.84 *20*	
		1422.7 *3*	20	604.48	9/2⁺	(M1(+E2))	−0.04 *4*	
		2027.2 *2*	40	0.0	5/2⁻			
2065.37	3/2,5/2,7/2⁻	1085.8 *3*	9	979.85	5/2⁺			
		1672.0 *2*	87	393.55	3/2⁻			
		2065.0 *2*	4	0.0	5/2⁻			
2083.33	1/2⁻,3/2,5/2⁻	1690.4[c]	<36[c]	393.55	3/2⁻			
		1898.5 *3*	28	184.629	3/2⁻			

$^{67}_{30}Zn_{37}$-4

^{64}Ni(α,nγ) (continued)

γ(^{67}Zn) (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[‡]	E_f	J^π_f	Mult.[&]	δ[&]	Comments
2083.33	1/2⁻,3/2,5/2⁻	1989.9[c] 3	<14[c]	93.30	1/2⁻			
		2083.5 3	22	0.0	5/2⁻			
2092.66		1908.0 2	100	184.629	3/2⁻			
2101.84		738.3 2	6	1363.61	5/2⁻			
		1214.1 4	34	887.71	5/2⁻			
		1287.0[c] 3	<48[c]	814.90	7/2⁻			
		2101.6 3	12	0.0	5/2⁻			
2136.9	9/2$^{(-)}$	1322.0 4	100	814.90	7/2⁻	(M1+E2)	−0.8 2	
2158.6		1973.9 4	100	184.629	3/2⁻			
2175.31		1196.1 4	19	979.85	5/2⁺			
		1287.4[c] 3	<44[c]	887.71	5/2⁻			
		1781.7[@] 4		393.55	3/2⁻			
		1990.2[c] 5	<37[c]	184.629	3/2⁻			I_γ: 37 (1978Du04); since this γ appears as a closely spaced doublet 1989.9 3 γ ray, the uncertainty was added by evaluator.
2242.84	1/2,3/2,5/2⁻	1100.1 4	25	1142.85	1/2⁻			
		1849.2 3	75	393.55	3/2⁻			
2272.9	3/2⁺,5/2⁺	669.2[d] 2		1603.68	7/2⁺			
		1879.3 3		393.55	3/2⁻			
2408.9	1/2⁺	1265.7[d] 6		1142.85	1/2⁻			
		2015.8 4		393.55	3/2⁻			
		2223.8 4		184.629	3/2⁻			
2428.1		2034.5 4	100	393.55	3/2⁻			
2434.6	11/2⁻	1619.7[#] 3	100	814.90	7/2⁻	E2(+M3)	+0.18 +11−18	
2451.81	13/2⁺	719.3[#] 2	35	1732.64	11/2⁺	M1+E2	+0.57 7	
		1846.9 3	<65	604.48	9/2⁺			E_γ: probably a doublet (1974Ni01).
2503.51	11/2⁺	863.5[#] 2	67	1640.09	13/2⁺			δ: −0.36 7 or −2.7 6 for M1+E2.
		1898.8[#] 3	33	604.48	9/2⁺			
2511.5		1697[@] 1		814.90	7/2⁻			
		2511 1		0.0	5/2⁻			
2554.6	1/2⁻,3/2⁻	2369.9[@] 8		184.629	3/2⁻			
		2554.5 10		0.0	5/2⁻			
2599.7	3/2⁺,5/2⁺	2415[@] 1		184.629	3/2⁻			
2732.2	11/2⁻	1215.0 2	100	1517.19	9/2⁻			δ: −0.17 10 or −2.5 +6−10 for M1+E2.
2926.4	(15/2⁺)	1286.4 4	100	1640.09	13/2⁺			
2937.3		1204.6 4	100	1732.64	11/2⁺			
3029.8	(11/2⁺, 15/2⁺)	1296.9 4	55 4	1732.64	11/2⁺			
		1389.9 4	45 4	1640.09	13/2⁺			
3065.9	13/2⁻	1548.6 5		1517.19	9/2⁻	E2(+M3)	+0.09 9	
3195.6		743.8 3	100	2451.81	13/2⁺			
3473.6	(11/2⁻, 13/2⁻)	407.7 9	100	3065.9	13/2⁻			

From ENSDF

^{64}Ni(α,nγ) (continued)

γ(^{67}Zn) (continued)

E_i(level)	J^π_i	E_γ†	I_γ‡	E_f	J^π_f	Comments
3487.3		1847.2 *3*	100	1640.09	$13/2^+$	E_γ: probably a doublet (1974Ni01).
3489.9		563.5 *3*		2926.4	$(15/2^+)$	
3490.7		1038.0 *10*	<20	2451.81	$13/2^+$	
		1850.9 *6*	>80	1640.09	$13/2^+$	
3696.7		1244.9 *5*	100	2451.81	$13/2^+$	
3929.6		440.6 *14*	10 *5*	3490.7		
		863.6 *5*	90 *5*	3065.9	$13/2^-$	
4220.0		1293.5 *5*		2926.4	$(15/2^+)$	
4630.0	$(21/2^+)$	1703.5 *6*		2926.4	$(15/2^+)$	
4684.2	$(21/2^-)$	464.2 *6*	33 *3*	4220.0		
		754.6 *8*	67 *3*	3929.6		

† For levels below 2600 from 1978Du04, and those above 2600 from 1977Ne04, except where noted otherwise.

‡ Percent photon branching from each level at 90° from 1978Du04, except where noted otherwise.

From 1974Ni01.

@ Weak transition seen only in coincidence (1978Du04).

& From adopted gammas.

[a] Branching derived from γ(θ) (1978Lo06).

[b] 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.

[c] Multiply placed with undivided intensity.

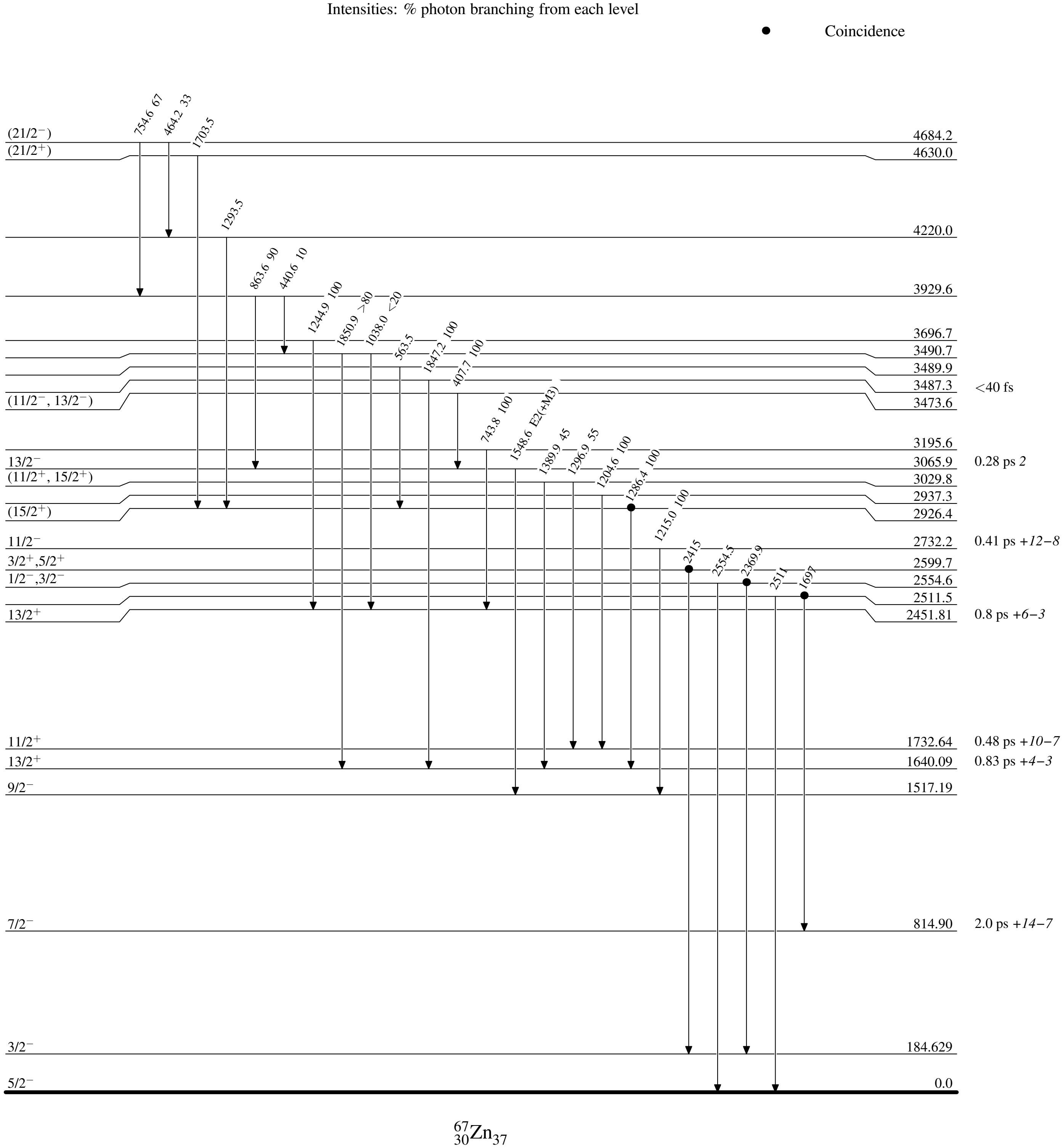
[d] Placement of transition in the level scheme is uncertain.

$^{67}_{30}Zn_{37}$-6

^{64}Ni(α,nγ)

Level Scheme

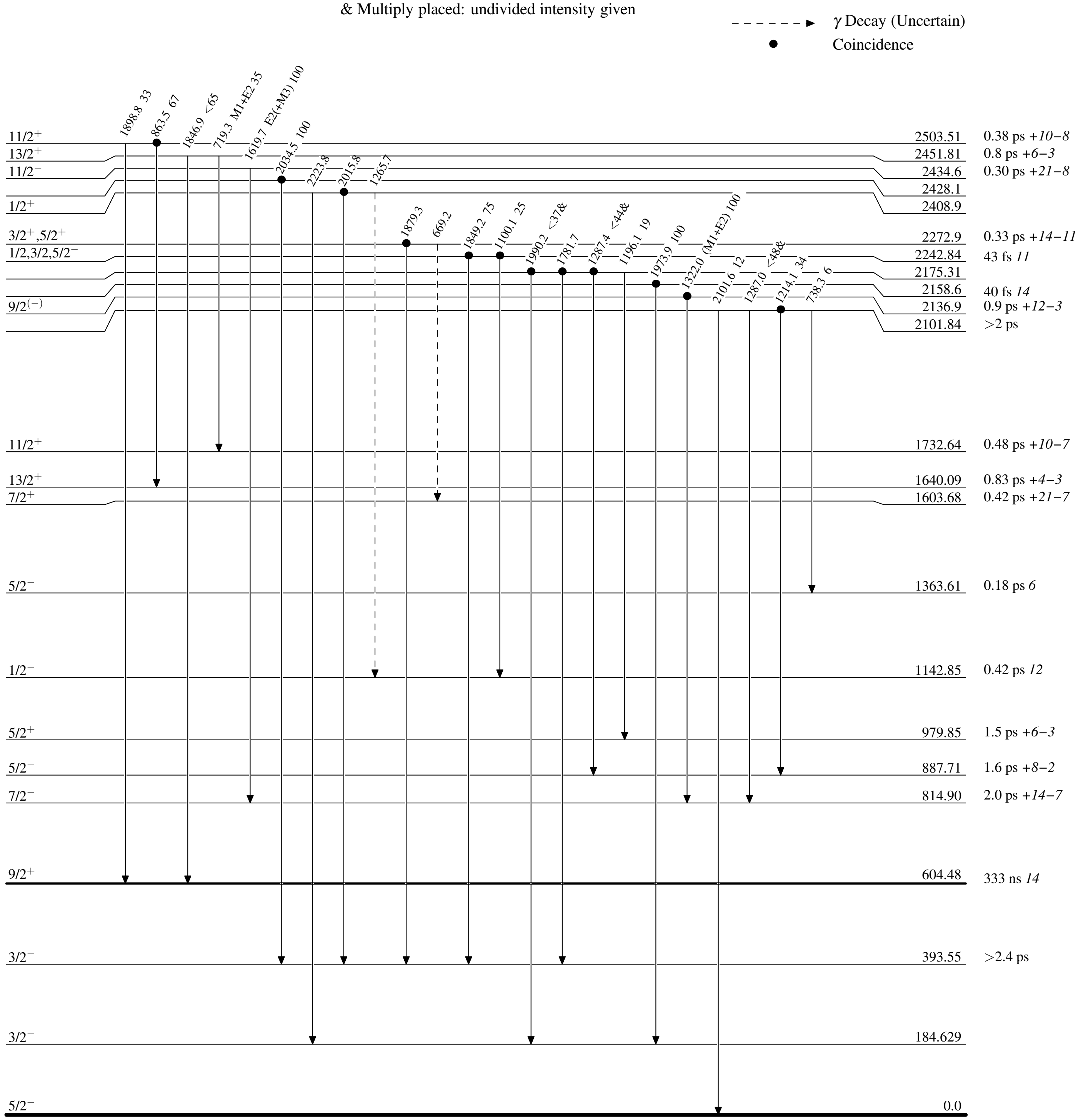
Intensities: % photon branching from each level



^{64}Ni(α,nγ)

Level Scheme (continued)

Intensities: % photon branching from each level
& Multiply placed: undivided intensity given



$^{67}_{30}Zn_{37}$

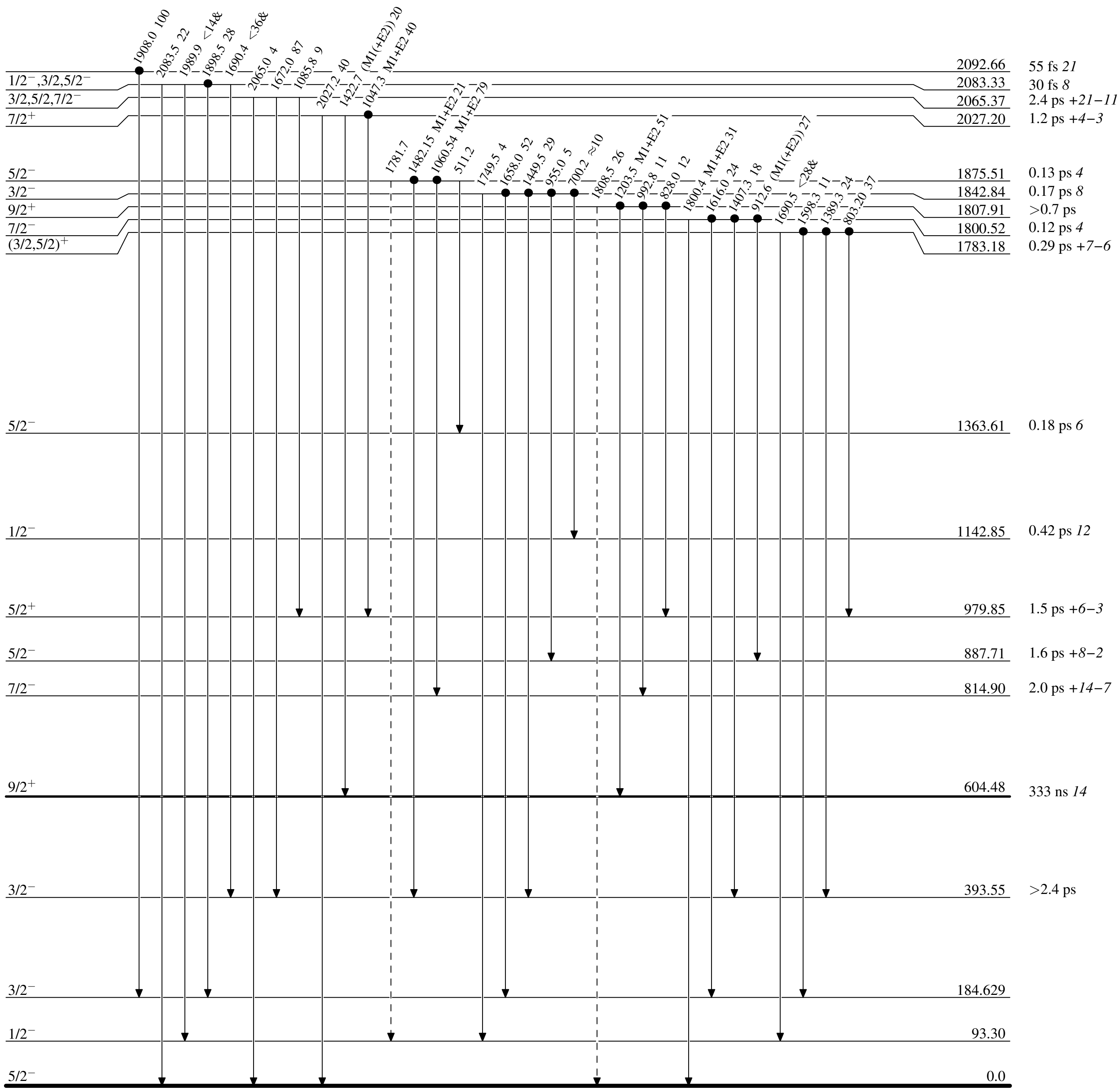
^{64}Ni(α,nγ)

Legend

Level Scheme (continued)

Intensities: % photon branching from each level
& Multiply placed: undivided intensity given

γ Decay (Uncertain)
● Coincidence



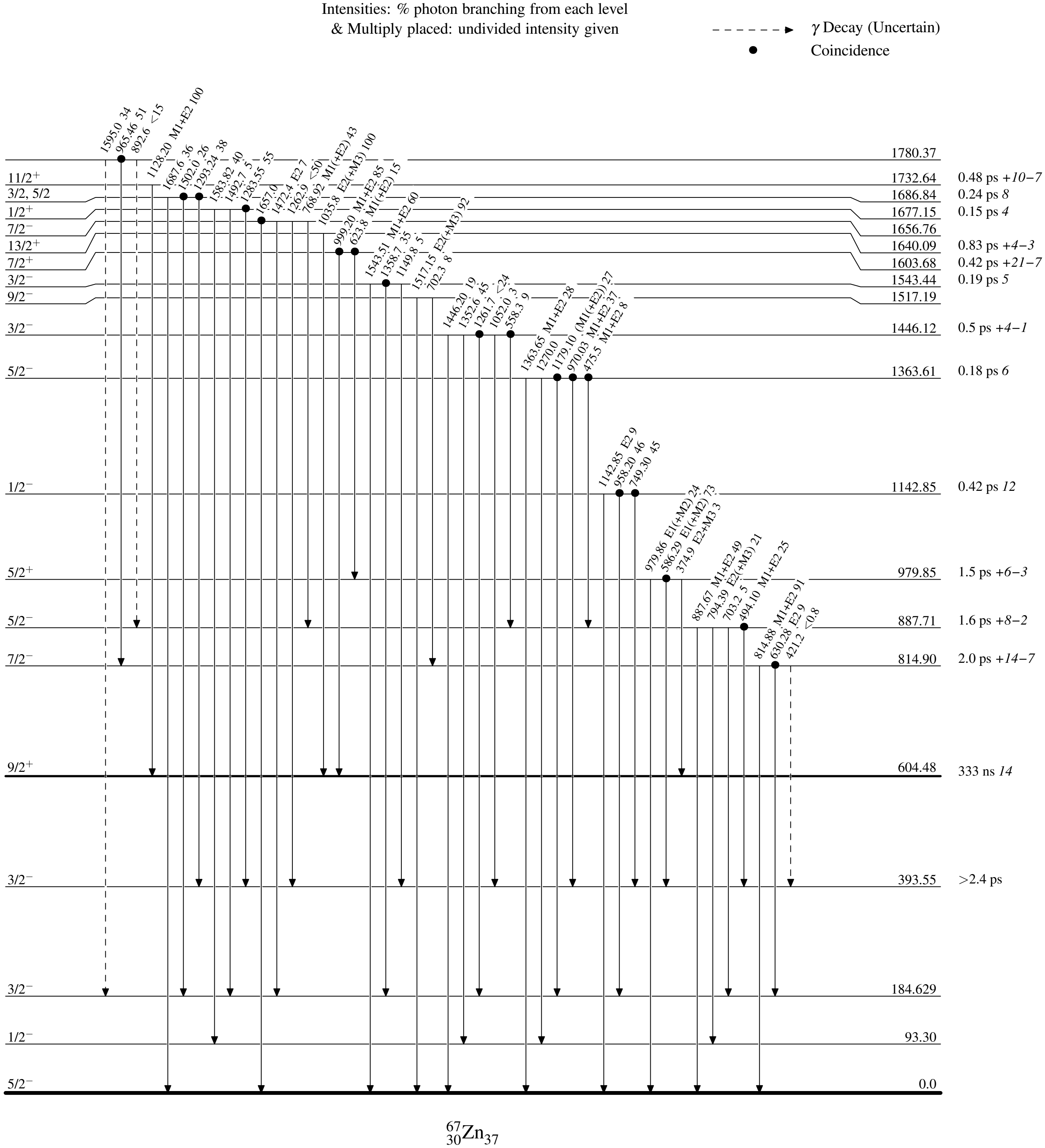
$^{67}_{30}Zn_{37}$

^{64}Ni(α,nγ)

Legend

Level Scheme (continued)

Intensities: % photon branching from each level
& Multiply placed: undivided intensity given



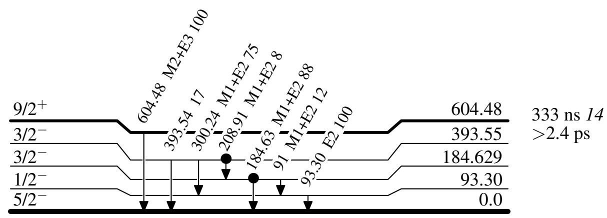
^{64}Ni(α,nγ)

Legend

Level Scheme (continued)

Intensities: % photon branching from each level
& Multiply placed: undivided intensity given

● Coincidence



$^{67}_{30}Zn_{37}$