^{70}Zn(p,nγ) 1984Fe03,1973Na17

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	G. Gürdal, E. A. Mccutchan	NDS 136, 1 (2016)	1-Jul-2016

1984Fe03: E(p)=3, 3.5 and 4 MeV. Measured Eγ, Iγ using two Ge(Li) detectors and E(ce), Ice using a superconducting-magnet transporter with Si(Li) detector and mini-orange Si(Li) electron spectrometers.
1975Hu06: E(p)=2.85, 3.4 MeV. Measured Eγ, γ(θ,t) using coaxial Ge(Li) detector; deduced $T_{1/2}$ of 879-keV level.
1974Ca14: E(p)=3.0 MeV. Measured Eγ, Iγ with Ge(Li) detector; $T_{1/2}$ using Doppler Shift Attenuation Method (DSAM).
1973Na17: E(p)=1.7-3.2 MeV. Measured Eγ, Iγ, γ(θ) using Ge(Li) detector.
1971Ar12: E(p)=1.4-4.0 MeV. Measured Eγ, γγ-coin, pγ-coin using Ge(Li) detector.
Others: 1966Re05, 1970Sa22, 1971Mi24, 1973Ca31, 1973KrZT, 1976KrZO.
The level scheme and spin assignments are based mainly on 1984Fe03 and 1973Na17.

^{70}Ga Levels

Results from γ(θ) analysis provided in the comments are from 1973Na17, except where noted.

E(level)[†]	Jπ[‡]	$T_{1/2}$[#]	Comments
0.0	1+		
508.1 *1*	2+		Jπ: γ(θ) gives J=2.
651.1 *1*	1+,2+		Jπ: γ(θ) consistent with J=1 or J=2.
690.9 *1*	2−		Jπ: γ(θ) consistent with J=1 or J=2.
878.6 *2*	4−	22.7 ns *5*	$T_{1/2}$: from γγ(t) in 1975Hu06. Jπ: γ(θ) consistent with J=4 (1975Hu06).
901.3 *1*	1+,2+,3+		Jπ: γ(θ) consistent with J=1-4.
995.4 *1*	2+		Jπ: γ(θ) gives J=2.
1002.6 *10*			
1009.2 *10*			
1009.5 *2*	1+,2+,3+		Jπ: γ(θ) consistent with J=1,2,3.
1014.9 *1*	1+,2+,3+		Jπ: γ(θ) consistent with J=1,2,3.
1023.9 *1*	2+,3+		Jπ: γ(θ) consistent with J=2,3.
1033.5 *2*	(5)−		
1101.5 *2*	2−,3−,4−		Jπ: γ(θ) consistent with J=1-4.
1135.4 *1*	1,2		Jπ: γ(θ) consistent with J=1,2.
1140.4 *1*	1,2		Jπ: γ(θ) consistent with J=1,2.
1203.8 *2*	2+	>220 fs	Jπ: γ(θ) gives J=2.
1236.1	(6)−		
1244.5	2	>500 fs	Jπ: γ(θ) gives J=2.
1253.1 *2*	3−,4−		Jπ: γ(θ) consistent with J=1-4.
1258.7 *2*	1+ to 4+		
1305.8 *2*			Jπ: γ(θ) consistent with J=1-4.
1307.0 *4*			
1312.1 *3*	1+,2+	170 fs *+50−25*	Jπ: γ(θ) consistent with J=1,2.
1336.6 *2*	2−		Jπ: γ(θ) gives J=2.
1359.4 *2*	2+		Jπ: γ(θ) gives J=2.
1413.0 *3*			
1445.9 *2*	1+,2+	0.27 ps *+56−9*	Jπ: γ(θ) consistent with J=1,2.
1456.4 *2*	1+,2+		Jπ: γ(θ) consistent with J=1,2.
1501.2 *5*	1+,2+		Jπ: γ(θ) consistent with J=1,2.
1518.3 *3*	1+,2+		Jπ: γ(θ) consistent with J=1,2.
1533.5 *1*	2+		Jπ: γ(θ) consistent with J=2,3.
1553.9 *6*	2+		Jπ: γ(θ) gives J=2.
1621.0 *5*	1−,2−		Jπ: γ(θ) consistent with J=1,2.
1633.5 *2*	1,2,3		Jπ: γ(θ) consistent with J=1,2,3.
1725.4 *10*			

Continued on next page (footnotes at end of table)

^{70}Zn(p,nγ) 1984Fe03,1973Na17 (continued)

^{70}Ga Levels (continued)

E(level)[†]	J^{π}[‡]	E(level)[†]	E(level)[†]	E(level)[†]
1793.9 *10*	$1^+,2^+,3^+$	1904.9 *10*	2190 *2*	2350 *2*
1807.4 *10*		1930.8 *7*	2214 *2*	2411 *2*
1823.2 *15*		2118 *2*	2231 *2*	
1865.0		2143 *2*	2320 *2*	

[†] From a least-squares fit to Eγ, by evaluators.

[‡] From the Adopted Levels. Cases where supporting evidence for J^{π} assignments originates from this dataset are indicated in the comments.

[#] From Doppler Shift Attenuation Method measurements in 1974Ca14, except where noted.

γ(^{70}Ga)

α(K)exp normalized to Hager-Seltzer value of 5.86×10^{-2} for the 187.6γ assumed to be E2; estimated uncertainty in data 10-36% (1984Fe03).

E_i(level)	J^π_i	E_γ[†]	I_γ[‡]	E_f	J^π_f	Mult.[@]	δ[&]	α[d]	Iγ′[#]	Comments
508.1	2$^+$	508.1 *1*	100	0.0	1$^+$	M1		0.00121	109 *7*	α(K)exp=9.7×10^{-04} *12* (1984Fe03) Mult.: A_2=−0.27 *5*, A_4=+0.05 *5* (1973Na17). δ: 0.00 +*10*−*7* from γ(θ) in 1973Na17.
651.1	1$^+$,2$^+$	651.2 *1*	100	0.0	1$^+$				37 *3*	Mult.: A_2=−0.20 *5*, A_4=+0.05 *5* (1973Na17). δ: −0.09 6 or +2.6 +*6*−*2* if 651-keV level has J=2, from γ(θ) in 1973Na17.
690.9	2$^-$	690.8 *1*	100	0.0	1$^+$	E1			100 *10*	α(K)exp=2.8×10^{-04} *10* (1984Fe03) Mult.: A_2=−0.31 *8*, A_4=+0.13 *8* (1973Na17), A_2=−0.30 *2*, A_4=+0.05 (1975Hu06). δ: −0.07 +*10*−*12* from γ(θ) in 1973Na17, 0.00 *6* or 2.7 *5* (1975Hu06).
878.6	4$^-$	187.6 *3*	100	690.9	2$^-$	E2			30 *5*	α(K) exp normalized to Hager Seltzer value for pure E2, α(K)=0.0586 (1984Fe03). Mult.: A_2=+0.17 *10*, A_4=+0.08 *9* (1973Na17). δ: δ(O/Q)=0.00 +*9*−*14* from γ(θ) in 1973Na17.
901.3	1$^+$,2$^+$,3$^+$	393.1 *1*	100 *9*	508.1	2$^+$	M1+E2	<0.7		14.1 *13*	α(K)exp=2.2×10^{-03} *4* (1984Fe03) Mult.: A_2=+0.20 *5*, A_4=−0.02 *5* (1973Na17). δ: from α(K)exp.
		902.5[ce] *10*	<15	0.0	1$^+$					
995.4	2$^+$	344.5 *2*	50 *13*	651.1	1$^+$,2$^+$	M1			1.1 *1*	α(K)exp=2.6×10^{-03} *8* (1984Fe03) Mult.: A_2=−0.27 *9*, A_4=+0.14 *9* (1973Na17). δ: +0.1 *2* from γ(θ) in 1973Na17.
		487.2 *1*	100 *9*	508.1	2$^+$				<7.6	
		995.9 *3*	66 *11*	0.0	1$^+$				4.4 *7*	Mult.: A_2=−0.35 *3*, A_4=+0.07 *3* (1973Na17). δ: 0.34 *9* or 1.2 *2* from γ(θ) in 1973Na17.
1002.6		1002.8 *10*	100	0.0	1$^+$				<1	
1009.2		1009.2[c] *10*	100	0.0	1$^+$				4.8 *13*	Iγ′: summed intensity for 1009.2 and 1010.3 doublet.
1009.5	1$^+$,2$^+$,3$^+$	318.5 *2*	100	690.9	2$^-$	D+Q			<19.8	α(K)exp=3.8×10^{-3} *10* (1984Fe03) Mult.: A_2=−0.10 *3*, A_4=−0.06 *3* (1973Na17). Mult.: M1 or E1+M2 from α(K)exp (1984Fe03). Decay scheme requires E1+M2.
		1010.3[c] *10*	24	0.0	1$^+$				4.8 *13*	Iγ′: summed intensity for 1009.2 and 1010.3 doublet.
1014.9	1$^+$,2$^+$,3$^+$	363.8 *1*	45	651.1	1$^+$,2$^+$	M1			4.0 *2*	α(K)exp=2.2×10^{-03} *5* (1984Fe03) Mult.: A_2=−0.05 *3*, A_4=+0.03 *3* (1973Na17).
		1014.4[ce] *6*	100	0.0	1$^+$				<8.8	
1023.9	2$^+$,3$^+$	515.7 *1*	100 *6*	508.1	2$^+$				6.2 *13*	Mult.: A_2=−0.22 *3*, A_4=−0.02 *3* (1973Na17).
		1023.3 *5*	10 *6*	0.0	1$^+$				0.6 *2*	
1033.5	(5)$^-$	154.9 *1*	100	878.6	4$^-$	D			7.7 *4*	α(K)exp=1.4×10^{-02} *5* (1984Fe03)

$^{70}_{31}Ga_{39}$-3

γ(^{70}Ga) (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[‡]	E_f	J^π_f	Mult.[@]	δ[&]	$I\gamma'$[#]	Comments
1101.5	$2^-,3^-,4^-$	410.6 *2*	100	690.9	2^-			3.5 *2*	Mult.: A_2=+0.21 *16*, A_4=−0.11 *15* (1973Na17).
1135.4	1,2	444.3 *4*	12 *5*	690.9	2^-			2.6 *2*	Mult.: A_2=−0.03 *8*, A_4=−0.16 *9* (1973Na17).
		1135.4 *1*	100 *5*	0.0	1^+			17.3 *28*	Mult.: A_2=+0.08 *1*, A_4=−0.03 *2* (1973Na17).
1140.4	1,2	632.3 *2*	49 *5*	508.1	2^+			4.5 *4*	Mult.: A_2=+0.06 *8*, A_4=−0.06 *7* (1973Na17).
		1140.4 *1*	100 *5*	0.0	1^+			11.8 *20*	Mult.: A_2=−0.03 *2*, A_4=+0.01 *2* (1973Na17).
1203.8	2^+	1203.8 *2*	100	0.0	1^+	D+Q	−0.10 *7*	<8.2	Mult.: A_2=−0.36 *4*, A_4=−0.16 *4* (1973Na17).
1236.1	$(6)^-$	203.2[e] *2*	100	1033.5	$(5)^-$			1.1 *1*	
1244.5	2	1244.6 *1*	100	0.0	1^+	D+Q	−0.05 *4*	10.7 *20*	Mult.: A_2=−0.37 *6*, A_4=−0.05 *5* (1973Na17).
1253.1	$3^-,4^-$	374.5 *1*	100 *6*	878.6	4^-	M1		9.3 *6*	α(K)exp=2.1×10^{-03} *5* (1984Fe03) Mult.: A_2=−0.10 *7*, A_4=−0.09 *7* (1973Na17).
		561.7 *4*	12 *6*	690.9	2^-			3.1 *3*	
1258.7	1^+ to 4^+	234.8 *1*	100	1023.9	$2^+,3^+$	M1		2.2 *3*	α(K)exp=7.3×10^{-03} *17* (1984Fe03)
		608.5[ce] *5*		651.1	$1^+,2^+$			<1.6	
1305.8		426.8 *2*	72 *7*	878.6	4^-			3.4 *3*	Mult.: A_2=−0.24 *9*, A_4=−0.08 *9* (1973Na17).
		798.6 *3*	100 *7*	508.1	2^+			5.1 *6*	
1307.0		1307.0 *4*	100	0.0	1^+			3.4 *4*	
1312.1	$1^+,2^+$	1312.1 *3*	100	0.0	1^+			11.7 *13*	Mult.: A_2=−0.02 *3*, A_4=0.00 *3* (1973Na17).
1336.6	2^-	645.7 *2*	100 *4*	690.9	2^-	D+Q	+1.8 *3*	11.0 *10*	Mult.: A_2=+0.25 *4*, A_4=+0.06 *3* (1973Na17).
		1337.0 *10*	9 *4*	0.0	1^+	D+Q	+0.51 *27*	<0.8	Mult.: A_2=+0.28 *9*, A_4=−0.15 *10* (1973Na17).
1359.4	2^+	708.6[ce] *10*		651.1	$1^+,2^+$				
		851.1 *2*	100 *13*	508.1	2^+	D+Q	−0.19 *2*	4.5 *6*	Mult.: A_2=+0.10 *1*, A_4=−0.01 *1* (1973Na17).
		1359.8 *4*	59 *8*	0.0	1^+	D+Q	+0.20 *8*	4.0 *5*	Mult.: A_2=+0.03 *4*, A_4=−0.07 *5* (1973Na17).
1413.0		904.9 *3*	100	508.1	2^+			1.5 *3*	
1445.9	$1^+,2^+$	755.0 *2*	9 *2*	690.9	2^-			4.5 *4*	
		794.6 *10*	2 *2*	651.1	$1^+,2^+$			1.0 *3*	
		1446.1[c] *5*	100 *10*	0.0	1^+				Mult.: A_2=−0.01 *2*, A_4=−0.02 *2* (1973Na17).
1456.4	$1^+,2^+$	432.3[c] *8*	25 *7*	1023.9	$2^+,3^+$			<1	
		554.3 *5*		901.3	$1^+,2^+,3^+$			<9.3	
		948.5 *3*	14 *6*	508.1	2^+			1.4 *3*	E_γ: no placement given in Table 1 of 1973Na17, however, γ ray is placed in Figure 2.
		1456.6[c] *8*	100 *7*	0.0	1^+				Mult.: A_2=−0.09 *2*, A_4=−0.03 *2* (1973Na17).
1501.2	$1^+,2^+$	1501.2[c] *5*	100	0.0	1^+				A_2=+0.02 *3*, A_4=−0.04 *3* (1973Na17).
1518.3	$1^+,2^+$	867.0 *3*	37 *5*	651.1	$1^+,2^+$			1.1 *4*	E_γ: no placement given in Table 1 of 1973Na17, however, γ ray is placed in Figure 2.
		1518.7[c] *6*	100 *10*	0.0	1^+				A_2=+0.04 *3*, A_4=−0.03 *3* (1973Na17).
1533.5	2^+	393.1[c] *1*	72 *11*	1140.4	1,2				
		882.8[c] *10*	40 *9*	651.1	$1^+,2^+$				
		1533.2[c] *8*	100 *9*	0.0	1^+	D+Q	+0.5 *4*		Mult.: A_2=+0.34 *5*, A_4=−0.12 *6* (1973Na17).
1553.9	2^+	1045.3[c] *8*	100 *10*	508.1	2^+	D+Q		6.8 *10*	Mult.: A_2=+0.17 *3*, A_4=−0.01 *3* (1973Na17). δ: =0.12 *6* or +2.93 *3* from $\gamma(\theta)$ in 1973Na17.
		1554.3[c] *8*	49 *6*	0.0	1^+	D+Q	+0.25 *9*		Mult.: A_2=+0.00 *7*, A_4=+0.10 *7* (1973Na17).
1621.0	$1^-,2^-$	930.4 *6*	4 *4*	690.9	2^-			0.6 *2*	
		969.5[c] *10*	92 *9*	651.1	$1^+,2^+$				

γ(^{70}Ga) (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[‡]	E_f	J^π_f	$I\gamma'$[#]	Comments
1621.0	$1^-,2^-$	1620.5[c] *8*	100 *10*	0.0	1^+		Mult.: A_2=+0.09 *4*, A_4=−0.07 *5* (1973Na17).
1633.5	1,2,3	982.2[c] *10*	57 *7*	651.1	$1^+,2^+$	2.7 *5*	
		1125.4 *2*	100 *10*	508.1	2^+	5.0 *8*	Mult.: A_2=−0.09 *4*, A_4=+0.01 *4* (1973Na17).
		1633.1[c] *10*	28 *6*	0.0	1^+		Mult.: A_2=−0.00 *5*, A_4=−0.06 *5* (1973Na17).
1725.4		1725.5[a] *7*	100	0.0	1^+		
1793.9	$1^+,2^+,3^+$	1794.2[a] *7*	100	0.0	1^+		
1807.4		1807.5[a] *10*	100	0.0	1^+		
1823.2		1823.2[a] *15*	100	0.0	1^+		
1865.0		1865.0[a] *7*	100	0.0	1^+		
1904.9		1904.8[a] *10*	100	0.0	1^+		
1930.8		1930.8[a] *7*	100	0.0	1^+		
2118		2118[b] *2*		0.0	1^+		
2143		2143[b] *2*		0.0	1^+		
2190		2190[b] *2*		0.0	1^+		
2214		2214[b] *2*		0.0	1^+		
2231		2231[b] *2*		0.0	1^+		
2320		2320[b] *2*		0.0	1^+		
2350		2350[b] *2*		0.0	1^+		
2411		2411[b] *2*		0.0	1^+		

† From 1984Fe03, except where noted.

‡ Relative photon branching from each level from 1973Na17.

\# From 1984Fe03, normalized to Iγ(691γ)=100.

@ Based on internal conversion data of 1984Fe03, except where noted.

& From $\gamma(\theta)$ in 1973Na17, except where noted.

[a] From 1970Sa22.

[b] From 1971Ar12.

[c] From 1973Na17.

[d] 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.

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

[x] γ ray not placed in level scheme.

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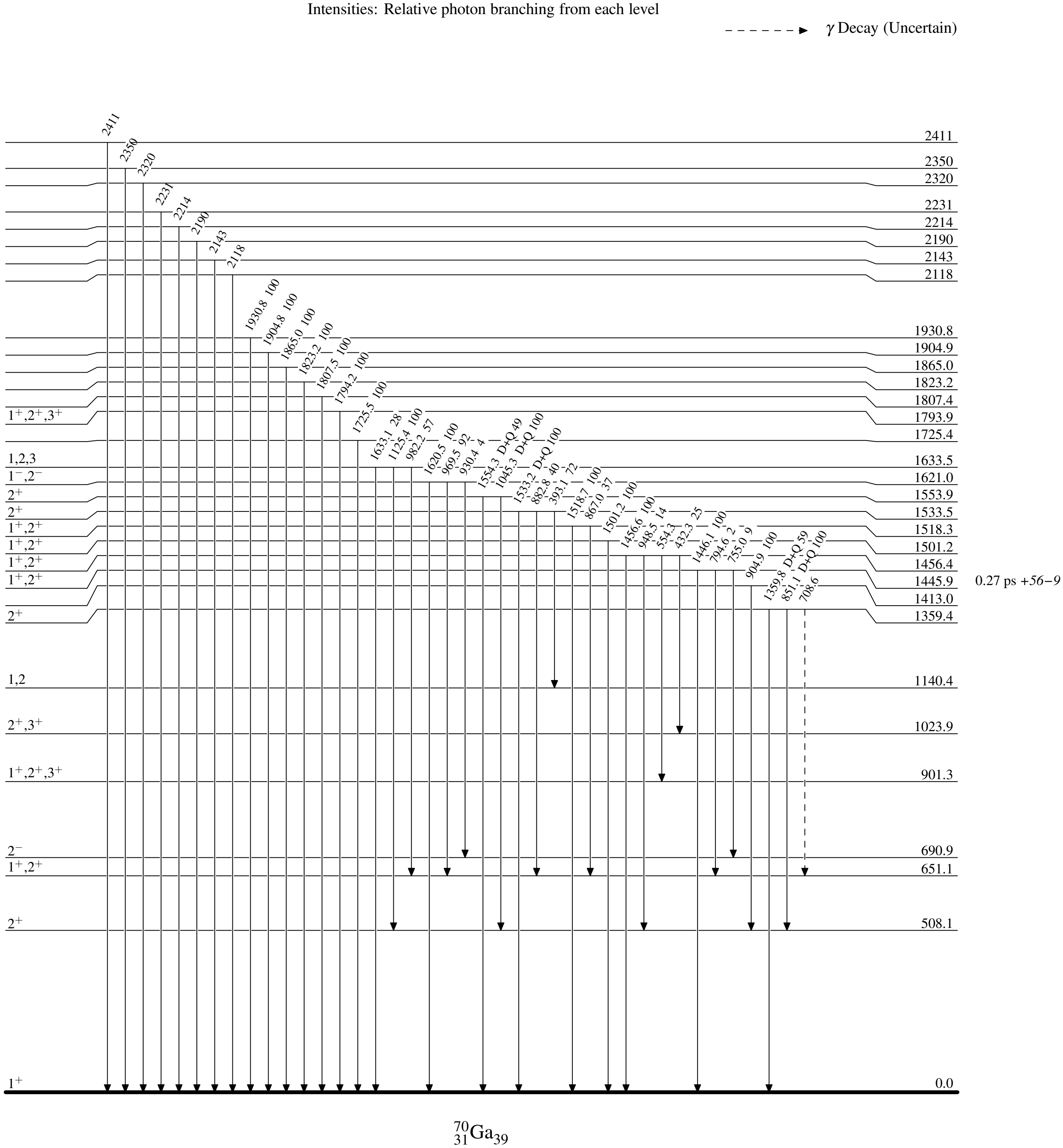
Level Scheme

Intensities: Relative photon branching from each level



^{70}Zn(p,nγ) 1984Fe03,1973Na17

Level Scheme (continued)

Intensities: Relative photon branching from each level

Legend

- - - - - - ► γ Decay (Uncertain)

● Coincidence