^{61}Ni(n,γ) E=thermal 1970Fa06

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Alan L. Nichols, Balraj Singh, Jagdish K. Tuli	NDS 113, 973 (2012)	15-Apr-2012

J^π(^{61}Ni g.s.)=3/2$^-$.

1970Fa06: 92.11% enriched ^{61}Ni target, Ge(Li) anti-Compton and pair spectrometers for singles, Ge(Li)-NaI(Tl) for $\gamma\gamma$ coincidences, NaI(Tl)-NaI(Tl) for $\gamma\gamma(\theta)$.

Others:

1966Gr13: one primary γ assigned to ^{62}Ni.

Additional information 1.

1975Wi06: natural Ni target, thermal neutrons, Ge(Li) spectrometer for singles, energies and relative intensities of five primary γ rays reported: Eγ (Iγ): 7703.4 *15* (0.16 *9*), 8302.5 *17* (0.13 *8*), 8551.3 *15* (0.58 *8*), 9422.3 *5* (0.19 *4*), 10594.6 *7*(0.16 *3*),

2007ChZX: PGAA database from Budapest-LBNL-IAEA work. Eγ and Iγ obtained at Budapest reactor using natural Ni target – listed under comments. 26 secondary and three primary γ rays identified in this work; intensities (in terms of elemental σ) are given for 16 γ rays, several of which are in disagreement with those from 1970Fa06 as indicated in comments. Source reference 2007ChZX is given in the comments below even though the actual data may exist in other databases connected with PGAA work such as on LBNL webpage: http://ie.lbl.gov/pgaadatabase/pgaa.htm.

All data are from 1970Fa06, unless otherwise stated.

^{62}Ni Levels

E(level)[†]	J$^\pi$[‡]	Comments
0.0	0$^+$	
1172.77 *9*	2$^+$	
2048.41 *12*	0$^+$	J$^\pi$: $\gamma\gamma(\theta)$ result is a clear signature of 0 ->2 -> 0 cascade.
2301.51 *9*	2$^+$	
2336.16 *16*	4$^+$	
2891.1 *3*	0$^+$[&]	2007ChZX list a 2891.00 *25* γ from this level without Iγ. This γ is not possible for 0$^+$ assignment.
3058.30 *17*	2$^+$	
3157.7 *3*	2$^+$	
3257.44 *23*	2$^+$	
3269.79 *20*	1,2$^+$[#]	
3370.2 *5*	1,2$^+$[#]	
3518.34 *18*	2$^+$	
3522.67 *18*	2$^+$,3[@]	
3756.7 *5*	3$^-$	2007ChZX list only a 3756.5 *5* γ from this level without Iγ. This γ is less likely for 3$^-$ assignment.
3849.22 *25*	0$^+$,1$^+$,2$^+$	2007ChZX list a 3849.12 *25* γ from this level without Iγ.
3859.7 *5*	1,2[#]	
3972.6 *4*	2$^+$	
4062.5 *5*	1,2[#]	
4151.0 *3*	2$^+$,3$^+$[@]	
4201.2 *4*	3$^-$,4$^-$,5$^-$	2007ChZX list only a 4201.0 *3* γ from this level without Iγ. This γ is not likely for 3$^-$,4$^-$,5$^-$ assignment.
4208.9 *21*		2007ChZX list a 4208.7 *15* γ from this level without Iγ.
4231.9 *21*	0$^+$	2007ChZX list a 4231.7 *15* γ from this level without Iγ. This γ is not possible for 0$^+$ assignment.
4317.0 *11*	1,2[#]	
4416.1 *6*	1,2[#]	
4627.4 *10*	2$^+$,3$^+$[@]	
4719.5 *7*	3 to 6$^-$	
4999.6 *14*	1,2,3$^-$[#]	
(10596.3[a] *4*)	1$^-$,2$^-$	

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^{61}Ni(n,γ) E=thermal 1970Fa06 (continued)

^{62}Ni Levels (continued)

† From least-squares fit to the Eγ data.
‡ From Adopted Levels, unless otherwise noted.
# γ to 0^+.
@ Primary γ from 1^-,2^- capture state; γ to 4^+.
& 2^+ deduced by 1970Fa06 from $\gamma\gamma(\theta)$ for the 1718-1173 cascade is in disagreement with $J^\pi=0^+$ from L(p,t)=0. Interference from other cascades in $\gamma\gamma(\theta)$ data obtained using a NaI(Tl)-NaI(Tl) system is probably the reason for an incorrect result.
[a] S(n)=10595.9 *3* (2011AuZZ). Others: 10596.5 *3* (2003Au03), 10595.6 *7* (1975Wi06), 10596.2 *15* (1970Fa06), 10597.2 *37* (1972Mo46).

γ(^{62}Ni)

Iγ normalization: From 1970Fa06.
Additional information 2.

E$_\gamma$‡	I$_\gamma$&	E$_i$(level)	J$_i^\pi$	E$_f$	J$_f^\pi$	Comments
x169.4† *5*	0.04 *2*					
x179.1† *6*	0.04 *2*					
x185.5† *5*	0.05 *2*					
x188.7† *5*	0.05 *2*					
x195.1† *7*	0.04 *2*					
x232.6† *5*	0.02 *1*					
x237.8† *4*	0.03 *1*					
x244.54† *15*	0.20 *3*					
x247.79† *25*	0.08 *2*					
264.94 *25*	0.10 *2*	3522.67	2^+,3	3257.44	2^+	
x295.6† *6*	0.07 *4*					
310.4 *5*	0.09 *4*	4627.4	2^+,3^+	4317.0	1,2	Other: Eγ=310.584 *21*, σ=0.00562 *11* (2007ChZX); when compared with data in 1970Fa06, the intensity of this γ in 2007ChZX is much too large to belong to ^{62}Ni.
x314.3† *6*	0.07 *4*					
x326.5† *5*	0.08 *4*					
x331.4† *8*	0.05 *3*					
x339.47† *20*	0.30 *5*					
450.4 *7*	0.04 *2*	3972.6	2^+	3522.67	2^+,3	
459.74 *25*	0.35 *5*	3518.34	2^+	3058.30	2^+	
464.63 *15*	1.5 *2*	3522.67	2^+,3	3058.30	2^+	
479.6 *10*	0.4 *3*	3370.2	1,2^+	2891.1	0^+	
x524.6† *4*	0.20 *6*					
x534.3† *6*	0.14 *5*					
x568.5† *5*	0.17 *10*					
x575.7† *5*	0.20 *7*					
579.42 *20*	0.55 *6*	3849.22	0^+,1^+,2^+	3269.79	1,2^+	
x590.8† *5*	0.20 *5*					
x654.9† *5*	0.30 *8*					
x675.2† *5*	0.36 *10*					
678.5 *3*	0.55 *15*	4201.2	3^-,4^-,5^-	3522.67	2^+,3	
x695.4† *7*	0.30 *10*					

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^{61}Ni(n,γ) E=thermal 1970Fa06 (continued)

$\gamma(^{62}Ni)$ (continued)

E_γ[‡]	I_γ[&]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[@]	δ[@]	Comments
703.1 *6*	0.20 *8*	3972.6	2^+	3269.79	$1,2^+$			
722.0 *5*	0.65 *20*	3058.30	2^+	2336.16	4^+			
756.8 *3*	1.55 *25*	3058.30	2^+	2301.51	2^+			
855.6 *5*	0.55 *20*	3157.7	2^+	2301.51	2^+			
875.64 *8*	14.3 *15*	2048.41	0^+	1172.77	2^+	Q		Other: Eγ=875.37 *12*, σ=0.00173 *25* (2007ChZX). (876γ)(1173γ)(θ): A_2=+0.365 *14*, A_4=+1.139 *20*.
968.2[a] *4*	<0.52[a]	3269.79	$1,2^+$	2301.51	2^+			
968.2[ab] *4*	<0.52[a]	3859.7	1,2	2891.1	0^+			
1045.9 *4*	0.50 *10*	4416.1	1,2	3370.2	$1,2^+$			Other: Eγ=1045.69 *20*, σ=0.00061 *13* (2007ChZX); when compared with data in 1970Fa06, the intensity of this γ in 2007ChZX is much larger than expected from Iγ of 1970Fa06.
1067.6 *8*	0.35 *10*	3370.2	$1,2^+$	2301.51	2^+			
1092.50 *25*	0.9 *2*	4151.0	$2^+,3^+$	3058.30	2^+			
1128.73 *10*	6.8 *8*	2301.51	2^+	1172.77	2^+			Other: Eγ=1128.82 *11*, σ=0.00123 *15* (2007ChZX). Mult.: >50% Q.
1163.30 *15*	5.8 *11*	2336.16	4^+	1172.77	2^+	Q		Other: Eγ=1163.31 *20*, σ=0.00145 *20* (2007ChZX).
1172.80 *10*	76 *4*	1172.77	2^+	0.0	0^+	Q		Other: Eγ=1172.88 *3*, σ=0.0122 *4* (2007ChZX).
1185.9 *4*	2.5 *4*	3522.67	$2^+,3$	2336.16	4^+			
1220.8[a] *4*	<5.2[a]	3269.79	$1,2^+$	2048.41	0^+			
1220.8[a] *4*	<5.2[a]	3522.67	$2^+,3$	2301.51	2^+			Other: Eγ=1220.83 *21*, σ=0.00076 *17* (2007ChZX). Mult.: 99% Q if J(3523)=2^+ (1970Fa06). (1221γ)(2301γ)(θ): A_2=−0.05 *6*, A_4=+0.22 *14*. (1221γ)(2301γ)(θ)+(2346γ)(1173γ)(θ): A_2=−0.14 *3*, A_4=+0.14 *6*.
1322.1 *6*	0.30 *10*	3370.2	$1,2^+$	2048.41	0^+			
1455.2 *5*	0.40 *10*	3756.7	3^-	2301.51	2^+			
1470.4 *5*	0.45 *10*	3518.34	2^+	2048.41	0^+			
[x]1538.6[†] *8*	0.30 *15*							
1548.0 *5*	0.5 *2*	3849.22	$0^+,1^+,2^+$	2301.51	2^+			
1661.3 *7*	0.4 *2*	4719.5	3 to 6^-	3058.30	2^+			
1718.26 *25*	1.2 *3*	2891.1	0^+	1172.77	2^+			(1718γ)(1173γ)(θ): A_2=+0.11 *8*, A_4=+0.28 *12*. For J(2891)=2, 1970Fa06 deduce δ(1718)=−4.1 *+13−30*.
1761.0 *5*	1.0 *2*	4062.5	1,2	2301.51	2^+			
1815.8 *8*	0.4 *2*	4151.0	$2^+,3^+$	2336.16	4^+			
1850.0 *7*	0.6 *2*	4151.0	$2^+,3^+$	2301.51	2^+			Other: Eγ=1850.9 *3*, σ=0.00106 *21* (2007ChZX); intensity of this γ in 2007ChZX is much larger than expected when compared with Iγ of 1970Fa06.
1886.2 *4*	1.7 *4*	3058.30	2^+	1172.77	2^+	D+Q	+0.65 *+20−15*	Other: Eγ=1885.0 *4*, σ=0.00068 *21* (2007ChZX). (1886γ)(1173γ)(θ): A_2=−0.18 *7*, A_4=+0.10 *10*.

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^{61}Ni(n,γ) E=thermal 1970Fa06 (continued)

γ(^{62}Ni) (continued)

E_γ ‡	I_γ &	E_i(level)	J_i^π	E_f	J_f^π	Mult. @	δ @	Comments
1985.1 *3*	4.1 *6*	3157.7	2^+	1172.77	2^+	D+Q	+0.13 *8*	(1985γ)(1173γ)(θ): A_2=+0.15 *6*, A_4=+0.06 *8*.
x2034.4† *7*	0.7 *3*							
x2048.7† *10*	0.5 *2*							
2084.2 *3*	4.0 *6*	3257.44	2^+	1172.77	2^+			Other: Eγ=2084.6 4, σ=0.00085 *22* (2007ChZX). (2084γ+2097γ)(1173γ)(θ): A_2=−0.154 *24*, A_4=+0.03 *4*.
2097.3 *3*	7.2 *12*	3269.79	$1,2^+$	1172.77	2^+			Other: Eγ=2098.2 3, σ=0.00170 *25* (2007ChZX). (2084γ+2097γ)(1173γ)(θ): A_2=−0.154 *24*, A_4=+0.03 *4*.
x2104.7† *7*	0.9 *3*							
x2155.8† *8*	0.5 *2*							
x2188.5† *15*	0.23 *15*							
x2196.5† *8*	0.4 *2*							
2289.7 *15*	0.28 *15*	4627.4	$2^+,3^+$	2336.16	4^+			
2301.41 *12*	10.4 *15*	2301.51	2^+	0.0	0^+			
2345.64 *20*	4.5 *9*	3518.34	2^+	1172.77	2^+	D+Q	+0.44 *9*	(2346γ)(1173γ)(θ): A_2=−0.07 *5*, A_4=+0.11 *7*. (2346γ)(1173γ)(θ)+(1221γ)(2301γ)(θ): A_2=−0.14 *3*, A_4=+0.14 *6*.
2583.6 *12*	0.5 *3*	3756.7	3^-	1172.77	2^+			
2799.4 *5*	1.8 *7*	3972.6	2^+	1172.77	2^+			(2799γ)(1173γ)(θ): A_2=+0.38 *15*, A_4=+0.10 *20*.
x2950† *2*	0.55 *20*							
x2961† *2*	0.6 *2*							
x2972.0† *15*	1.05 *20*							
x2984† *2*	0.65 *20*							
x3032† *2*	0.35 *20*							
3060 *2*	0.5 *1*	3058.30	2^+	0.0	0^+			
x3095† *2*	0.6 *1*							
3158.0 *15*	1.7 *2*	3157.7	2^+	0.0	0^+			Eγ: other: 3157.6 3 (2007ChZX).
x3175† *2*	0.3 *1*							
x3207† *2*	0.4 *1*							
3270 *1*	1.6 *2*	3269.79	$1,2^+$	0.0	0^+			
x3295.0† *15*	0.6 *1*							
3370 *2*	1.6 *4*	3370.2	$1,2^+$	0.0	0^+			Eγ: other: 3370.1 4 (2007ChZX).
x3443† *2*	0.4 *1*							
3456 *3*	0.35 *10*	4627.4	$2^+,3^+$	1172.77	2^+			
x3474† *3*	0.25 *10*							
3518 *3*	0.3 *1*	3518.34	2^+	0.0	0^+			Eγ: other: 3518.23 *18* (2007ChZX).
3546 *2*	0.35 *10*	4719.5	3 to 6^-	1172.77	2^+			Other: Eγ=3544.9 *4*, σ=0.0010 *3* (2007ChZX); intensity of this γ in 2007ChZX is much larger than expected when compared with Iγ of 1970Fa06.
x3812† *2*	0.55 *10*							
3828 *2*	0.55 *10*	4999.6	$1,2,3^-$	1172.77	2^+			
3860.0 *15*	1.6 *2*	3859.7	1,2	0.0	0^+			Eγ: other: 3859.2 *5* (2007ChZX).
x3880† *2*	0.4 *1*							
x3963† *4*	0.15 *10*							

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^{61}Ni(n,γ) E=thermal 1970Fa06 (continued)

γ(^{62}Ni) (continued)

E_γ ‡	I_γ &	E_i(level)	J_i^π	E_f	J_f^π	Comments
3972.0 *15*	1.2 *2*	3972.6	2^+	0.0	0^+	Other: 3972.7 *4*, σ=0.0022 *4* (2007ChZX); intensity of this γ in 2007ChZX is much larger than expected when compared with Iγ of 1970Fa06.
x3981† *3*	0.5 *1*					
x3990† *2*	0.45 *10*					
x4035† *2*	0.6 *1*					
x4043† *3*	0.25 *10*					
4061 *2*	0.9 *1*	4062.5	1,2	0.0	0^+	E_γ: other: 4062.4 *5* (2007ChZX).
x4127† *2*	0.45 *10*					
4318 *3*	0.25 *10*	4317.0	1,2	0.0	0^+	E_γ: other: 4316.9 *11* (2007ChZX).
x4341† *2*	0.35 *10*					
x4379† *2*	0.3 *1*					
4416 *2*	0.4 *1*	4416.1	1,2	0.0	0^+	
x4424† *2*	0.35 *10*					
x4482† *2*	0.25 *10*					Additional information 3.
x4566† *2*	0.2 *1*					
x4713† *2*	0.25 *10*					
x4731† *3*	0.15 *10*					
x4850.0† *15*	0.5 *1*					
x4880† *3*	0.25 *10*					
4998 *2*	0.45 *10*	4999.6	1,2,3$^-$	0.0	0^+	E_γ: other: 4999.4 *13* (2007ChZX).
x5018† *2*	0.3 *1*					
x5037† *2*	0.45 *10*					
x5052† *3*	0.15 *10*					
x5074† *3*	0.15 *10*					
x5162.0† *15*	0.5 *1*					
x5292.0† *15*	0.8 *1*					
x5300† *3*	0.15 *10*					
x5354† *2*	0.25 *10*					
x5386.0† *15*	0.5 *1*					
x5440† *3*	0.2 *1*					
x5539† *2*	0.4 *1*					
x5570† *2*	0.2 *1*					
5596 *4*	0.15 *10*	(10596.3)	1$^-$,2$^-$	4999.6	1,2,3$^-$	Other: Eγ=5594.07 *21*, σ=0.0066 *6* (2007ChZX); when compared with data in 1970Fa06, the intensity of this γ in 2007ChZX is much too large to belong to ^{62}Ni.
x5607† *2*	0.35 *10*					
5877 *2*	0.3 *1*	(10596.3)	1$^-$,2$^-$	4719.5	3 to 6$^-$	
5968 *2*	0.7 *1*	(10596.3)	1$^-$,2$^-$	4627.4	2$^+$,3$^+$	
x6018† *3*	0.25 *10*					
x6035† *3*	0.2 *1*					
x6087† *3*	0.25 *10*					
6179 *2*	1.0 *2*	(10596.3)	1$^-$,2$^-$	4416.1	1,2	
6277 *3*	0.4 *2*	(10596.3)	1$^-$,2$^-$	4317.0	1,2	
6364 *2*	0.5 *3*	(10596.3)	1$^-$,2$^-$	4231.9	0^+	
6387 *2*	0.4 *2*	(10596.3)	1$^-$,2$^-$	4208.9		
6395 *2*	0.5 *3*	(10596.3)	1$^-$,2$^-$	4201.2	3$^-$,4$^-$,5$^-$	
6445 *2*	1.2 *2*	(10596.3)	1$^-$,2$^-$	4151.0	2$^+$,3$^+$	

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^{61}Ni(n,γ) E=thermal 1970Fa06 (continued)

$\gamma(^{62}Ni)$ (continued)

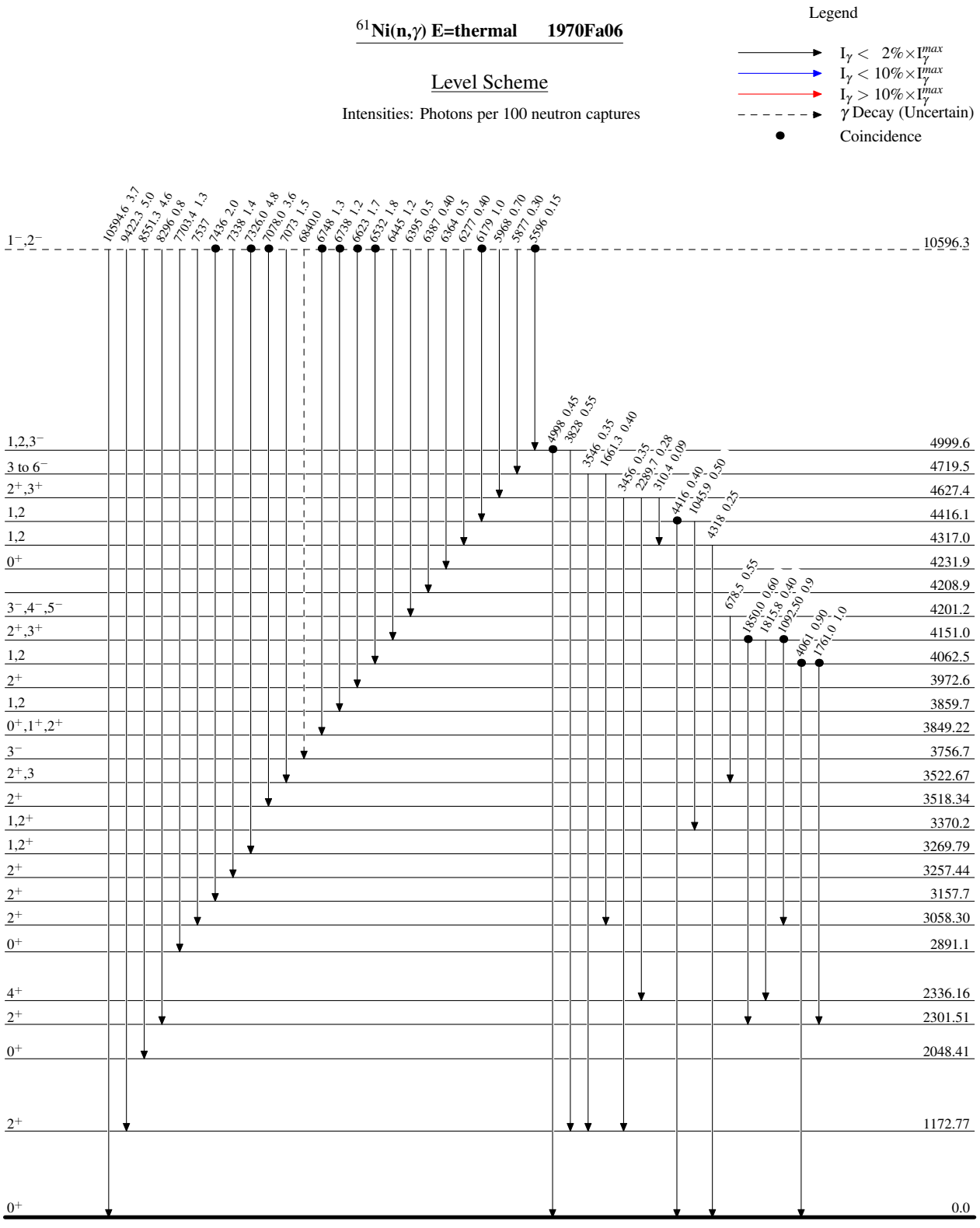
E_γ ‡	I_γ &	E_i(level)	J_i^π	E_f	J_f^π	Comments
6532 *2*	1.8 *4*	(10596.3)	$1^-,2^-$	4062.5	1,2	
6623 *2*	1.7 *3*	(10596.3)	$1^-,2^-$	3972.6	2^+	E_γ: other: 6629 (1967Ba79).
6738 *3*	1.2 *2*	(10596.3)	$1^-,2^-$	3859.7	1,2	E_γ: other: 6716 *5* (1967Ba79).
6748 *3*	1.3 *2*	(10596.3)	$1^-,2^-$	3849.22	$0^+,1^+,2^+$	
6840.0[b] *15*		(10596.3)	$1^-,2^-$	3756.7	3^-	E_γ: also assigned to ^{62}Ni(n,γ), Iγ=(5.9 *4*).
7073 *3*	1.5 *7*	(10596.3)	$1^-,2^-$	3522.67	2^+,3	
7078.0 *15*	3.6 *7*	(10596.3)	$1^-,2^-$	3518.34	2^+	
7326.0 *15*	4.8 *4*	(10596.3)	$1^-,2^-$	3269.79	$1,2^+$	
7338 *2*	1.4 *3*	(10596.3)	$1^-,2^-$	3257.44	2^+	
7436 *2*	2.0 *3*	(10596.3)	$1^-,2^-$	3157.7	2^+	
7537 *2*		(10596.3)	$1^-,2^-$	3058.30	2^+	E_γ: also assigned to ^{60}Ni(n,γ), Iγ=(1.7 *3*).
7703.4# *15*	1.3 *6*	(10596.3)	$1^-,2^-$	2891.1	0^+	E_γ: γ not reported by 1970Fa06; given as 7693 *5* by 1967Ba79. I_γ: estimated by evaluators from a comparison of various relevant Iγ values given in 1975Wi06 and 1970Fa06.
8296 *3*	0.8 *2*	(10596.3)	$1^-,2^-$	2301.51	2^+	E_γ: from 1970Fa06 compares with a value of 8302.5 *17* from 1975Wi06 – latter results in a level at 2294 *2*, which differs significantly from 2301.8 level in Adopted Levels.
8551.3# *15*	4.6 *5*	(10596.3)	$1^-,2^-$	2048.41	0^+	E_γ: others: 8545 *3* (1970Fa06), 8525 *5* (1967Ba79).
9422.3# *5*	5.0 *5*	(10596.3)	$1^-,2^-$	1172.77	2^+	E_γ: others: 9425 *3* (1970Fa06), 9417 *8* (1967Ba79). Other: Eγ=9421.67 *24*, σ=0.00245 *25* (2007ChZX).
10594.6# *7*	3.7 *8*	(10596.3)	$1^-,2^-$	0.0	0^+	E_γ: other: 10597 *3* (1970Fa06). Other: Eγ=10592.9 *4*, σ=0.00114 *13* (2007ChZX).

† Assignment to ^{62}Ni is uncertain since 1970Fa06 did not identify this γ ray with any particular nuclide.
‡ When comparisons are possible, the Eγ values of 1970Fa06 in the 1-3 MeV region are 0.1-0.2 keV lower than those from other experiments of similar precision.
# From 1975Wi06.
@ From $\gamma\gamma(\theta)$ (1970Fa06).
& For intensity per 100 neutron captures, multiply by 1.00 *20*.
[a] Multiply placed with undivided intensity.
[b] Placement of transition in the level scheme is uncertain.
[x] γ ray not placed in level scheme.

^{61}Ni(n,γ) E=thermal 1970Fa06

Level Scheme

Intensities: Photons per 100 neutron captures



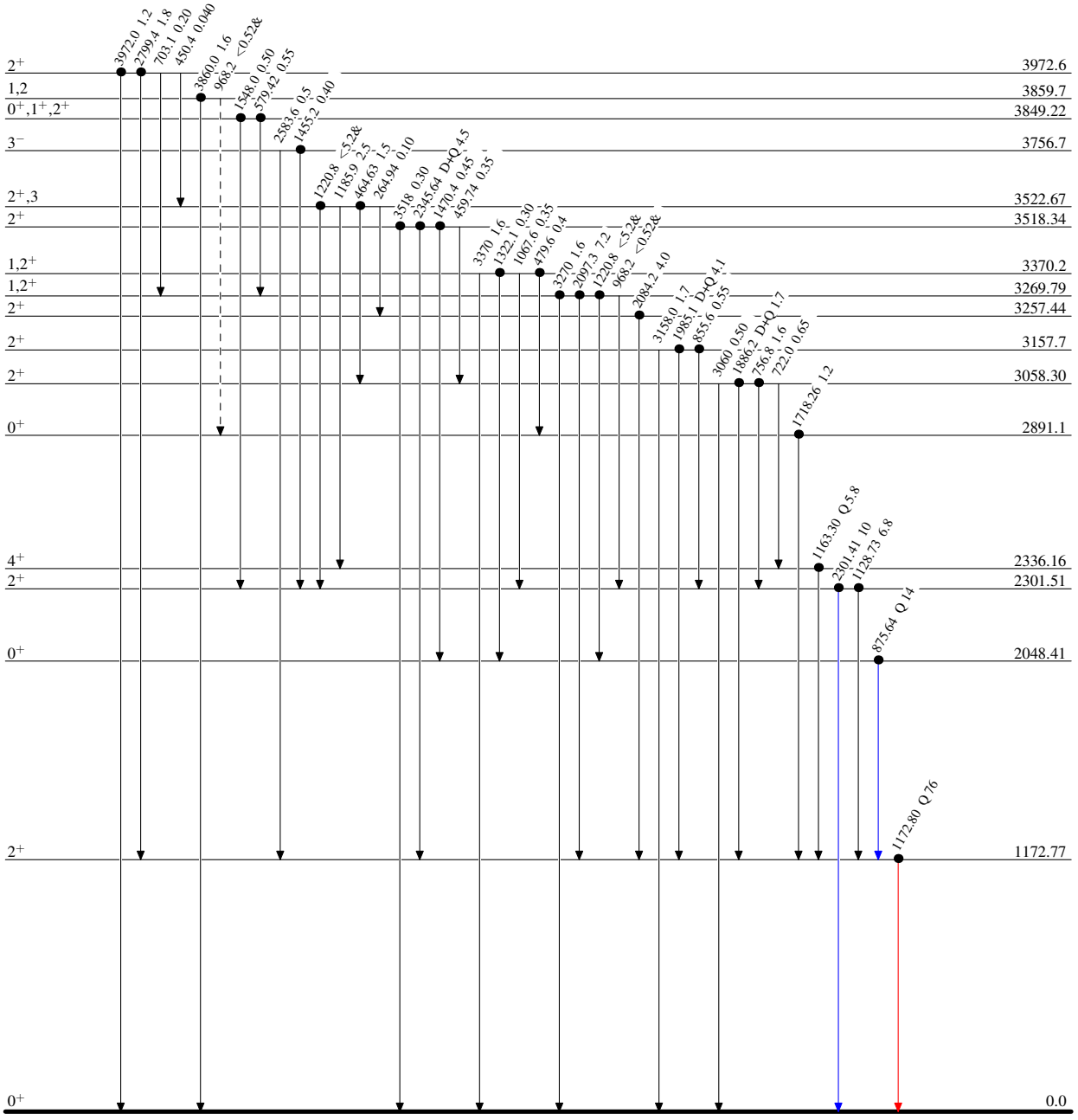
$^{62}_{28}Ni_{34}$

^{61}Ni(n,γ) E=thermal 1970Fa06

Level Scheme (continued)

Intensities: Photons per 100 neutron captures
& Multiply placed: undivided intensity given

Legend
- $I_\gamma < 2\% \times I_\gamma^{max}$
- $I_\gamma < 10\% \times I_\gamma^{max}$
- $I_\gamma > 10\% \times I_\gamma^{max}$
- γ Decay (Uncertain)
- Coincidence



$^{62}_{28}Ni_{34}$