

Adopted Levels, Gammas

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	A. A. Sonzogni, M. Fadil, and B. Pfeiffer		NDS 110,2815 (2009)	30-Sep-2009

$Q(\beta^-)=1835$ 26; $S(n)=8678$ 4; $S(p)=13567$ 3; $Q(\alpha)=-8837.3$ 28 [2012Wa38](#)

$S(2n)=14496.4$ 24, $S(2p)=25110.6$ 30 ([2012Wa38](#)).

[Additional information 1.](#)

^{84}Se evaluated by A.A. Sonzogni, M. Fadil, and B. Pfeiffer .

Precise atomic mass measurement: [2008Ha23](#) (Penning-trap system). Other: [2006Ha62](#).

A 1360 γ has been assigned feeding the 2121 level in ^{252}Cf SF decay, while a 1361.4 γ in $^{208}\text{Pb}(^{16}\text{O},\text{F}\gamma)$ ([2004Pr10](#)) and a

1361.5 γ in $^{238}\text{U}(p,\text{F}\gamma)$ ([2013DrZY](#)) has been placed feeding the 3537 level from a 4898 level. Evaluator treats the placement in ^{252}Cf SF decay as uncertain.

 ^{84}Se LevelsCross Reference (XREF) Flags

A	^{84}As β^- decay (4.02 s)	E	Coulomb excitation	I	$^{238}\text{U}(p,\text{F}\gamma)$:prompt γ
B	^{85}As β^-n decay (2.021 s)	F	$^{192}\text{Os}(^{82}\text{Se},\text{X}\gamma)$	J	$^{238}\text{U}(^{82}\text{Se},^{84}\text{Se}\gamma)$
C	^{252}Cf SF decay	G	$^9\text{Be},^{197}\text{Au}(^{84}\text{Se},^{84}\text{Se}'\gamma)$		
D	$^{82}\text{Se}(t,p)$	H	$^{208}\text{Pb}(^{18}\text{O},\text{X}\gamma)$		

E(level) [‡]	J ^π [†]	T _{1/2}	XREF	Comments
0.0 [@]	0 ⁺	3.26 min 10	ABCDEFGHIJ	% β^- =100 T _{1/2} : weighted average of 3.1 min 1 (1974KrZG), 3.1 min 2 (1975Hu02), 3.5 min 1 (1970Ei02), 3.1 min 2 (1968Re12), and 3.3 min 3 (1960Sa05).
1454.55 [@] 8	2 ⁺	0.42 ps 7	ABCDEFGHIJ	B(E2) \uparrow =0.105 15 (2010Ga14) B(E2) from $^{197}\text{Au}(^{84}\text{Se},^{84}\text{Se}\gamma)$; deduced T _{1/2} 1/2=0.42 ps 7.
1967 3	(0 ⁺)		D	
2097 11	(1 ⁻)		D	
2121.65 [@] 10	4 ⁺	20.2 ps +41-26	ABC EFGHIJ	J ^π : E2 γ to 2 ⁺ ; systematics of N=50 nuclei. T _{1/2} : From RDDS, plunger method (2015Li42).
2244 7	0 ⁺		D	
2461.38 9	(1,2 ⁺)		A	J ^π : γ rays to 0 ⁺ and (2 ⁺).
2654 4	0 ⁺		D	
2699.47 12	(2,3,4)		AB	J ^π : γ 's to (2 ⁺) and (4 ⁺).
2716 10	(0 ⁺)		D	
2740 11	(0 ⁺)		D	
2984.75 13	2 ⁺		A D J	
3024.30 12	(2 ⁺)		A D	
3069.77 22			A	
3125.97 15			A	
3232.43 14			A	
3297.05 12			AB	
3370.54 16	(6 ⁺)	8.2 ps +17-39	A C F HIJ	J ^π : γ to 4 ⁺ ; shell-model prediction (2013DrZY). T _{1/2} : From RDDS, plunger method (2015Li42). XREF: J(?).
3408.73 14			A J	
3439.15 13			A J	
3481.7? 10			C	E(level): assuming 1360 γ feeds the 2121.6 level. See comment on top.
3537.09 18	(5 ⁺)		C F HIJ	J ^π : level fed from (6 ⁺) and γ to (4 ⁺), supported by shell model calculations.
3541.23 10	2 ⁺		A d G	J ^π : L(t,p)=2 for E(level)=3544 6.
3548.3 3			A d	J ^π : L(t,p)=2 for E(level)=3544 6.
3698 6			D	

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Adopted Levels, Gammas (continued) ^{84}Se Levels (continued)

E(level) [‡]	J ^π [†]	XREF	Comments
3701.47 ^{&} 19	(6 ⁺)	C F HI J	J ^π : Q γ to (4 ⁺) and D γ to (5 ⁺), supported by shell model calculations.
3862.5 10		F	
3872.01 14		A	
3928 9	2 ⁺	D G	XREF: D(3934). E(level): assumed that 3934 8 in (t,p) is the same as 3916 11 in (^{84}Se , $^{84}\text{Se}'\gamma$); listed level energy is the weighted average of the two.
3985.27 22	2 ⁺	A D	
4082.18 22		A	
4106 17	0 ⁺	D	
4116.33 17		A	
4226 4	2 ⁺	D	
4282.12 11		A	
4307 7	(2 ⁺)	D	
4405.8 ^{#&} 3	(7 ⁺)	C F HI	J ^π : γ to (6 ⁺).
4445.19 [#] 22	(4 ⁺)	A D	
4602 6	2 ⁺	D	
4641.0		I J	XREF: J(?).
4670 9	(2 ⁺)	D	
4723 6		D	
4813 5	(2 ⁺)	D	
4898.5 4	(6 ⁺)	HI	E(level): assuming 1361 γ feeds the 3537 level. See comment on top. J ^π : shell-model prediction (2013DrZY).
4903 7	(2 ⁺ ,0 ⁺)	D	
4981 9	1 ⁻	D	
5139 6	2 ⁺	D	
5161.17 18		A	
5185 6	2 ⁺	D	
5221.96 16		A	
5258 6	4 ⁺	D	
5295 9	2 ⁺	D	
5329.9 ^{&}	(8 ⁺)	I	
5373 9		D	
5437 [#] 9	(5 ⁻)	D	
5507 9	2 ⁺	D	
5596.16 20	3 ⁻	A D	
5627 9	2 ⁺	D	
5637.6 3		A	
5661.53 23		A	
5725 14		D	
5815 12	2 ⁺	D	
5869.34 23		A	
5890.1 3	(3 ⁻ ,1 ⁻)	A D	
5922 [#] 9	(4 ⁺)	D	
6005 [#] 12	(4 ⁺)	D	
6019.90 19		A	
6249.60 21		A	
6329 21	2 ⁺	D	
6400.4 3	4 ⁺	A D	
6414.4 ^{&}	(9,10)	I	
6541.5 3		A	
6604.6 3		A	

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Adopted Levels, Gammas (continued) ^{84}Se Levels (continued)

[†] From L-values observed in $^{82}\text{Se}(t,p)$ (1988Mu02), unless otherwise stated.

[‡] Levels connected by γ rays are from least-squares fit to E_γ ; others are from $^{82}\text{Se}(t,p)$.

L(t,p) has possible admixture of L=0 indicating possibility for a doublet.

@ Band(A): Ground state sequence.

& Band(B): Sequence based on (6^+).

$\gamma(^{84}\text{Se})$						
$E_i(\text{level})$	J_i^π	E_γ^\dagger	I_γ^\dagger	E_f	J_f^π	Mult. Comments
1454.55	2^+	1454.66 10	100	0.0	0^+	E2 B(E2)(W.u.)=9.6 14 E $_\gamma$: weighted average of 1454.55 10 (^{84}As β^- decay), 1455.1 2 (^{85}As β^-n decay), 1454.5 2 ($^{208}\text{Pb}(^{18}\text{O},X\gamma)$), 1454.7 1 ($^{192}\text{Os}(^{82}\text{Se},X\gamma)$). Other: E $_\gamma$ =1455.1 (^{252}Cf SF decay). Mult.: from $^{208}\text{Pb}(^{18}\text{O},X\gamma)$.
2121.65	4^+	666.99 7	100	1454.55	2^+	E2 B(E2)(W.u.)=10.0 +16-17 E $_\gamma$: weighted average of 666.97 10 (^{84}As β^- decay), 667.1 2 (^{85}As β^-n decay), 666.8 3 ($^{208}\text{Pb}(^{18}\text{O},X\gamma)$), 667.0 1 ($^{192}\text{Os}(^{82}\text{Se},X\gamma)$). Other: E $_\gamma$ =667.1 (^{252}Cf SF decay). Mult.: from $^{208}\text{Pb}(^{18}\text{O},X\gamma)$.
2461.38	($1,2^+$)	1007.12 10	41.9 17	1454.55	2^+	E $_\gamma$: weighted average of 577.84 10 (^{84}As β^- decay), 577.5 2 (^{85}As β^-n decay). I $_\gamma$: weighted average of 100 3 (^{84}As β^- decay), 100 15 (^{85}As β^-n decay). E $_\gamma$: weighted average of 1245.3 2 (^{84}As β^- decay), 1244.6 2 (^{85}As β^-n decay). I $_\gamma$: weighted average of 85 5 (^{84}As β^- decay), 67 12 (^{85}As β^-n decay).
		2461.35 15	100 5	0.0	0^+	
2699.47	(2,3,4)	577.77 14	100 3	2121.65	4^+	
		1245.0 4	82 6	1454.55	2^+	
2984.75	2^+	522.2	9.5	2461.38	($1,2^+$)	E $_\gamma$, I $_\gamma$: observed only in ^{84}As β^- decay. E $_\gamma$: weighted average of 1843.13 10 (^{84}As β^- decay), 1843.7 2 (^{85}As β^-n decay). I $_\gamma$: from ^{84}As β^- decay. B(E2)(W.u.)=1.1 +8-2 E $_\gamma$: weighted average of 1249.0 2 (^{84}As β^- decay), 1248.7 2 ($^{208}\text{Pb}(^{18}\text{O},X\gamma)$), 1249.0 3 ($^{192}\text{Os}(^{82}\text{Se},X\gamma)$). Other: E $_\gamma$ =1249.6 (^{252}Cf SF decay).
		1530.19 10	100 5	1454.55	2^+	
3024.30	(2^+)	325.03 10	5.3 16	2699.47	(2,3,4)	
		1569.53 10	100 3	1454.55	2^+	
3069.77		1615.2 2	100	1454.55	2^+	
3125.97		426.4 2	29 15	2699.47	(2,3,4)	
		1671.45 15	100 8	1454.55	2^+	
3232.43		1110.77 10	100	2121.65	4^+	
3297.05		1175.9 2	9.8 8	2121.65	4^+	
		1843.24 24	100 3	1454.55	2^+	
3370.54	(6^+)	1248.88 13	100	2121.65	4^+	[E2] B(E2)(W.u.)=1.1 +8-2 E $_\gamma$: weighted average of 1249.0 2 (^{84}As β^- decay), 1248.7 2 ($^{208}\text{Pb}(^{18}\text{O},X\gamma)$), 1249.0 3 ($^{192}\text{Os}(^{82}\text{Se},X\gamma)$). Other: E $_\gamma$ =1249.6 (^{252}Cf SF decay).
3408.73		1287.06 10	100	2121.65	4^+	E $_\gamma$: weighted average of 1415.3 2 ($^{208}\text{Pb}(^{18}\text{O},X\gamma)$),
3439.15		1317.45 10	100 5	2121.65	4^+	
		1984.7 2	23.6 14	1454.55	2^+	
3481.7?		1360	100	2121.65	4^+	
3537.09	(5^+)	1415.30 17	100	2121.65	4^+	

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Adopted Levels, Gammas (continued) $\gamma(^{84}\text{Se})$ (continued)

$E_i(\text{level})$	J_i^π	E_γ^\dagger	I_γ^\dagger	E_f	J_f^π	Mult.	Comments
							1415.3 3 ($^{192}\text{Os}(^{82}\text{Se}, X\gamma)$). Other: $E_\gamma=1415$ (^{252}Cf SF decay).
3541.23	2 ⁺	1080.15 10	15.8 7	2461.38	(1,2 ⁺)		
		2086.69 10	100 4	1454.55	2 ⁺		
3548.3		1426.6 3	100	2121.65	4 ⁺		
3701.47	(6 ⁺)	164.18 21	41 8	3537.09	(5 ⁺)	D	E_γ : weighted average of 164.1 2 ($^{208}\text{Pb}(^{18}\text{O}, X\gamma)$), 164.7 5 ($^{192}\text{Os}(^{82}\text{Se}, X\gamma)$). Other: $E_\gamma=165$ (^{252}Cf SF decay).
							I_γ : weighted average of 80 40 ($^{208}\text{Pb}(^{18}\text{O}, X\gamma)$), 39 8 ($^{192}\text{Os}(^{82}\text{Se}, X\gamma)$).
							Mult.: from $\gamma(\theta)$ in $^{192}\text{Os}(^{82}\text{Se}, X\gamma)$.
		1580.00 21	100 15	2121.65	4 ⁺	Q	E_γ : weighted average of 1579.8 3 ($^{208}\text{Pb}(^{18}\text{O}, X\gamma)$), 1580.2 3 ($^{192}\text{Os}(^{82}\text{Se}, X\gamma)$). Other: $E_\gamma=1580$ (^{252}Cf SF decay).
							I_γ : weighted average of 100 21 ($^{208}\text{Pb}(^{18}\text{O}, X\gamma)$), 100 22 ($^{192}\text{Os}(^{82}\text{Se}, X\gamma)$).
							Mult.: from $\gamma(\theta)$ in $^{192}\text{Os}(^{82}\text{Se}, X\gamma)$.
3862.5		492.0 [‡]	100	3370.54	(6 ⁺)		
3872.01		573.9	21.4	3297.05			
		1750.35 10	100 4	2121.65	4 ⁺		
3928	2 ⁺	2462 11	100	1454.55	2 ⁺		
3985.27	2 ⁺	1863.6 2	100	2121.65	4 ⁺		
4082.18		1960.5 2	100	2121.65	4 ⁺		
4116.33		574.9	77	3541.23	2 ⁺		
		2661.74 15	100 5	1454.55	2 ⁺		
4282.12		741.23 10	100 9	3541.23	2 ⁺		
		985.20 10	61.3 21	3297.05			
		2159.0 2	31.7 21	2121.65	4 ⁺		
		4280.9 3	27.9 17	0.0	0 ⁺		
4405.8	(7 ⁺)	704.34 24	100	3701.47	(6 ⁺)		E_γ : weighted average of 704.4 4 ($^{208}\text{Pb}(^{18}\text{O}, X\gamma)$), 704.3 3 ($^{192}\text{Os}(^{82}\text{Se}, X\gamma)$). Other: $E_\gamma=703.5$ (^{252}Cf SF decay).
4445.19	(4 ⁺)	2323.5 2	100	2121.65	4 ⁺		
4641.0		1270.0		3370.54	(6 ⁺)		
4898.5	(6 ⁺)	1361.4 4	100	3537.09	(5 ⁺)		
5161.17		3039.46 15	100	2121.65	4 ⁺		
5221.96		1925.5 2	73 5	3297.05			
		2522.10 15	100 5	2699.47	(2,3,4)		
5329.9	(8 ⁺)	924.4		4405.8	(7 ⁺)		
5596.16	3 ⁻	2299.0 2	90 7	3297.05			
		3474.6 3	100 7	2121.65	4 ⁺		
5637.6		4182.9 3	100	1454.55	2 ⁺		
5661.53		2962.0 2	100	2699.47	(2,3,4)		
5869.34		3169.4 3	100 6	2699.47	(2,3,4)		
		3748.0 3	94 6	2121.65	4 ⁺		
5890.1	(3 ⁻ , 1 ⁻)	4435.4 3	100	1454.55	2 ⁺		
6019.90		2722.80 15	100	3297.05			
6249.60		2840.8 2	53 13	3408.73			
		4127.9 3	100 7	2121.65	4 ⁺		
6400.4	4 ⁺	4945.7 3	100	1454.55	2 ⁺		
6414.4	(9,10)	1084.5		5329.9	(8 ⁺)		
6541.5		5086.8 3	100	1454.55	2 ⁺		
6604.6		5149.9 3	100	1454.55	2 ⁺		

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Adopted Levels, Gammas (continued)

 $\gamma(^{84}\text{Se})$ (continued)

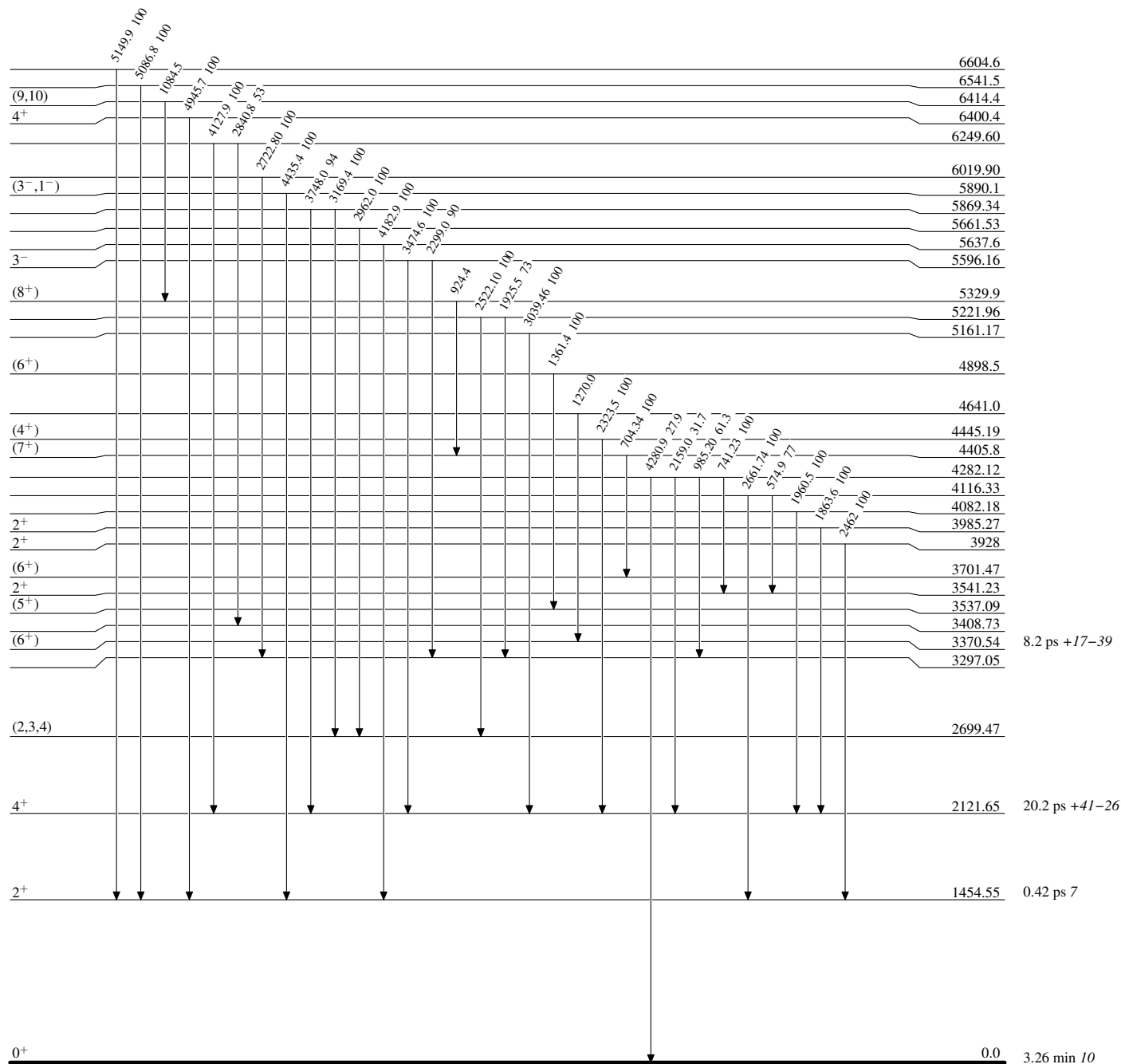
[†] From the corresponding dataset when only one XREF is available. Otherwise, see individual comments for the source.

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

Adopted Levels, Gammas

Level Scheme

Intensities: Relative photon branching from each level

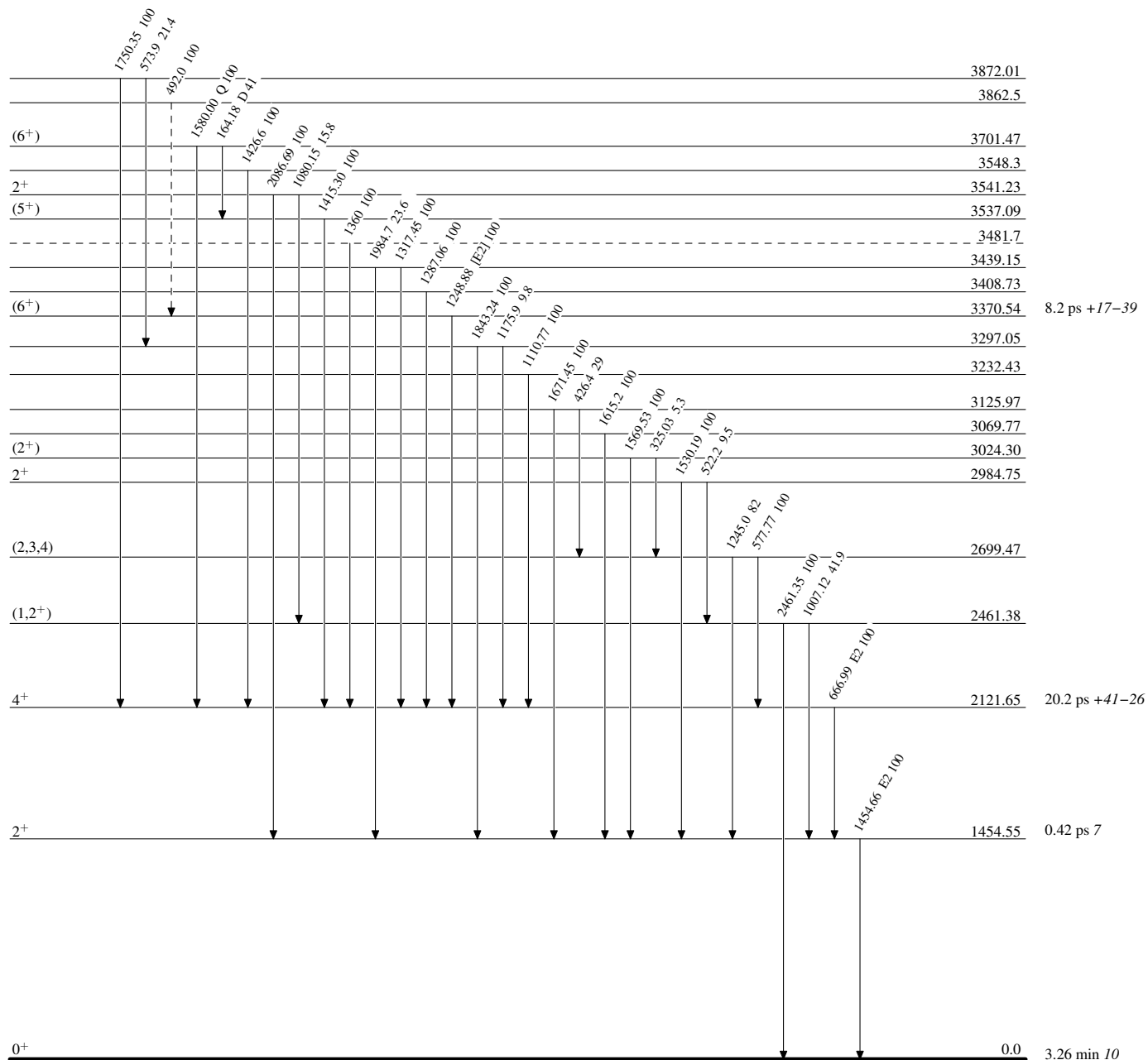


Adopted Levels, Gammas

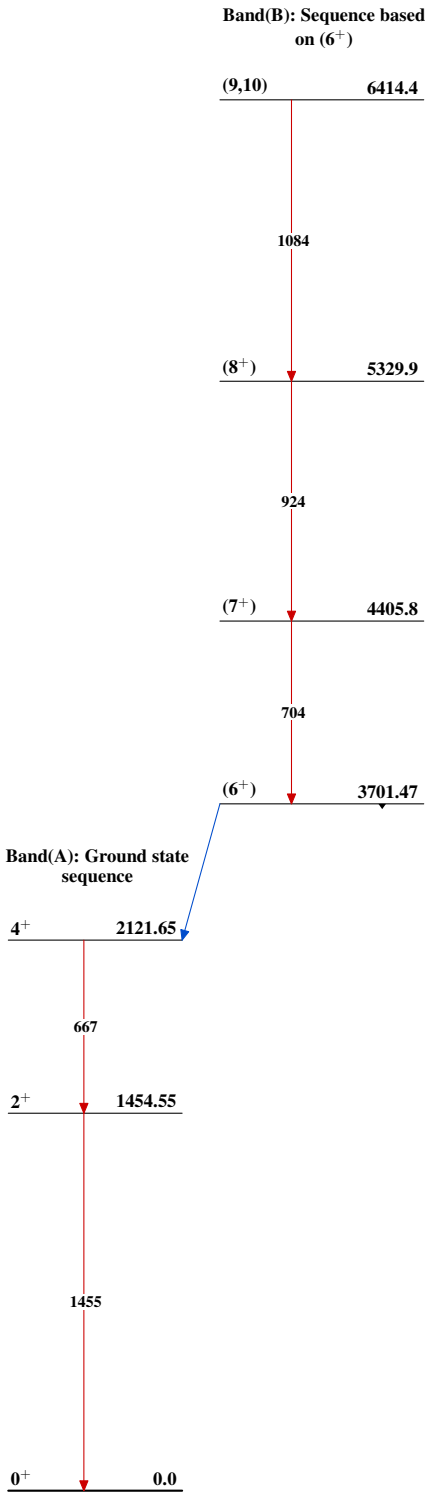
Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

-----► γ Decay (Uncertain)

Adopted Levels, Gammas



$^{84}_{34}\text{Se}_{50}$