^{161}Yb ε decay 1981Ad02

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	C. W. Reich	NDS 112,2497 (2011)	1-Jun-2011

Parent: ^{161}Yb: E=0; J^π=3/2$^-$; $T_{1/2}$=4.2 min *2*; Q(ε)=4056 *32*; %ε+%β^+ decay=?

^{161}Yb-J^π: Additional information 1.

^{161}Yb-$T_{1/2}$: Additional information 2.

^{161}Yb-Q(ε): Additional information 3.

Additional information 4.

^{161}Yb produced by 660-MeV proton spallation on Ta and Hf targets, followed by isotope separation. γ singles and $\gamma\gamma$(t) coincidences measured with Ge detectors. ce spectra measured using Si(Li) and magnetic spectrometers and γce coincidences.

Because of the many unplaced γ's, the large gap between the energy of the highest reported level and the Q(ε) value, and the uncertain status of the mults of some low-energy transitions, the evaluator regards the extraction of ε decay-branch intensities from intensity-balance considerations as unreliable. Consequently, ε decay branch intensities, as well as a γ-intensity normalization, are not quoted here.

^{161}Tm Levels

All data are from 1981Ad02, unless otherwise noted; measured γ singles, $\gamma\gamma$(t) coincidences, ce spectra, and γce coincidences. Additional information 5.

E(level)[†‡#]	J^π[&]	$T_{1/2}$[@]	Comments
0[c]	7/2$^+$	38 min *4*	$T_{1/2}$: from ^{161}Tm Adopted Levels.
7.4[d] *2*	1/2$^+$		E(level): from the in-beam data of 1984Fo04. This level was not directly observed by 1981Ad02, who claimed only that its energy was less than a few tens of keV.
18.90[e] *9*	5/2$^+$	<50 ns	$T_{1/2}$: from the existence of coincidences of the deexciting 18.90 γ with gammas feeding this level, 1981Ad02 derive this upper limit.
22.80[ad] *24*	3/2$^+$		
78.20[f] *3*	7/2$^-$	112 ns *5*	$T_{1/2}$: from 1981Ad02. Other: 140 ns *20* also from 1981Ad02.
159.12[e] *11*	7/2$^+$		
167.24[abd] *25*	5/2$^+$		
211.07[ad] *25*	7/2$^+$		
337.52[ah] *20*	1/2$^+$,3/2$^+$		
367.4[ag] *3*	1/2$^-$		
433.3[bh] *3*	3/2$^+$,5/2,7/2$^+$		
465.8[b] *3*			
625.5[b] *3*			
638.74 *12*			
647.89 *13*			
678.08 *9*	5/2$^-$		
709.66 *9*	5/2$^-$		
1180.70 *12*			

† From least-squares fit to γ energies, except for the value assigned by the evaluator to the 7.4-keV level.

‡ In 1981Ad02, energies were not determined for the 1/2[411] band members and for the levels proposed as the bandheads of 3/2[411] and 1/2[541]. From in-beam studies (1984Fo04), the position of the 1/2$^+$ level was determined, so the evaluator has been able to assign energies to these remaining levels.

From energy differences of 7 keV among the unplaced γ's, levels at 722, 800, 813, and 823 keV are possible, but are not included.

@ From ^{161}Yb ε decay studies only. See ^{161}Tm Adopted Levels for additional data for the 78-keV level.

Continued on next page (footnotes at end of table)

^{161}Yb ε decay 1981Ad02 (continued)

^{161}Tm Levels (continued)

[&] From adopted values.
[a] Value deduced by evaluator from placement of $1/2^+$ level at 7.4 keV.
[b] 1981Ad02 tentatively placed a 140.25 γ between levels assigned as the $3/2^+$ and $5/2^+$ members of the 1/2[411] band, making this γ doubly placed. These authors indicated that an alternative would be to place a 144.43 γ between these two levels. In light of subsequent in-beam studies, the evaluator has chosen this latter placement. This has led to the energy of this level being revised upward from that shown by 1981Ad02.
[c] Band(A): g.s. band. configuration=7/2[404].
[d] Band(B): 1/2[411] band.
[e] Band(C): 5/2[402] band.
[f] Band(D): 7/2[523] band.
[g] Band(E): 1/2[541] band.
[h] Band(F): possible 3/2[411] band.

γ(^{161}Tm)

All data are from 1981Ad02, unless otherwise noted; measured γ singles, γγ(t) coincidences, ce spectra, and γce coincidences.

E_γ	I_γ[†‡]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[#]	α[@]	Comments
(7.4)		7.4	1/2+	0	7/2+	[M3]	4.47×10^8	ce(M)/(γ+ce)=0.791 *8*; ce(N+)/(γ+ce)=0.209 *4* ce(N)/(γ+ce)=0.188 *4*; ce(O)/(γ+ce)=0.0210 *5*; ce(P)/(γ+ce)=0.000149 *3*
(15.4)		22.80	3/2+	7.4	1/2+	[M1,E2]	1.0×10^4 *10*	ce(L)/(γ+ce)=0.8 *6*; ce(M)/(γ+ce)=0.18 *24*; ce(N+)/(γ+ce)=0.05 *7* ce(N)/(γ+ce)=0.04 *6*; ce(O)/(γ+ce)=0.005 *7*; ce(P)/(γ+ce)=4.E−6 *4* α: Value computed for δ=1. Note that the minimum value is α=124, the value for a pure M1 transition.
18.90 *12*		18.90	5/2+	0	7/2+	M1	67.7 *16*	ce(L)/(γ+ce)=0.768 *12*; ce(M)/(γ+ce)=0.171 *6*; ce(N+)/(γ+ce)=0.0461 *15* ce(N)/(γ+ce)=0.0401 *13*; ce(O)/(γ+ce)=0.00575 *19*; ce(P)/(γ+ce)=0.000309 *11* Mult.: δ is ≤0.10.
70.90 *10*	3.7 *8*	709.66	5/2−	638.74				
78.28 *3*	260 *20*	78.20	7/2−	0	7/2+	E1	0.635	α(K)=0.522 *8*; α(L)=0.0887 *13*; α(M)=0.0198 *3*; α(N+..)=0.00513 *8* α(N)=0.00452 *7*; α(O)=0.000589 *9*; α(P)=2.25×10^{-5} *4* Mult.: δ is ≤0.045.
140.25 *8*	21.5 *20*	159.12	7/2+	18.90	5/2+	D		
144.43 *6*	35 *4*	167.24	5/2+	22.80	3/2+			
159.67 *19*	4.5 *10*	625.5		465.8				
^{x}161.85 *15*	5.3 *10*							
188.28 *5*	27.2 *20*	211.07	7/2+	22.80	3/2+	[E2]	0.318	α(K)=0.195 *3*; α(L)=0.0950 *14*; α(M)=0.0229 *4*; α(N+..)=0.00586 *9* α(N)=0.00522 *8*; α(O)=0.000633 *9*; α(P)=8.99×10^{-6} *13* Mult.: γ(θ) suggests γ is dipole, but placement has ΔJ=2.
192.26 *14*	4.4 *4*	625.5		433.3	3/2+,5/2,7/2+			
^{x}197.7 *5*	≈0.3							
222.37 *20*	1.8 *3*	433.3	3/2+,5/2,7/2+	211.07	7/2+			E_γ: placement is that proposed by 1984Fo04, from ^{152}Sm(^{14}N,5nγ). γ is observed, but unplaced, by 1981Ad02.
^{x}261.2 *3*	1.8 *5*							
266.0 *5*	6.0 *20*	433.3	3/2+,5/2,7/2+	167.24	5/2+			
298.46 *15*	10.3 *6*	465.8		167.24	5/2+			
^{x}310.3 *3*	3.4 *6*							
314.70 *15*	20.3 *8*	337.52	1/2+,3/2+	22.80	3/2+	M1(+E2)	0.09 *4*	α(K)=0.08 *3*; α(L)=0.0143 *16*; α(M)=0.0033 *3*; α(N+..)=0.00087 *9* α(N)=0.00076 *7*; α(O)=0.000104 *16*; α(P)=4.4×10^{-6} *21*

γ(^{161}Tm) (continued)

$E_γ$	$I_γ$ †‡	E_i(level)	$J^π_i$	E_f	$J^π_f$	Mult.#	α@	Comments
318.63 *18*	4.9 *4*	337.52	1/2+,3/2+	18.90	5/2+			$E_γ$: placement is that proposed by 1984Fo04, from ^{152}Sm(^{14}N,5nγ). γ is observed, but unplaced, by 1981Ad02.
330.10 *24*	21.0 *13*	337.52	1/2+,3/2+	7.4	1/2+	M1(+E2)	0.08 *3*	α(K)=0.07 *3*; α(L)=0.0124 *16*; α(M)=0.0028 *3*; α(N+..)=0.00075 *9* α(N)=0.00065 *8*; α(O)=9.0×10^{-5} *15*; α(P)=3.9×10^{-6} *19*
344.72 *28*	11.0 *10*	367.4	1/2−	22.80	3/2+	[E1]	0.01371	α(K)=0.01157 *17*; α(L)=0.001672 *24*; α(M)=0.000370 *6*; α(N+..)=9.86×10^{-5} *14* α(N)=8.60×10^{-5} *13*; α(O)=1.205×10^{-5} *17*; α(P)=5.99×10^{-7} *9*
359.92 *17*	8.5 *6*	367.4	1/2−	7.4	1/2+	[E1]	0.01237	α(K)=0.01044 *15*; α(L)=0.001505 *22*; α(M)=0.000333 *5*; α(N+..)=8.88×10^{-5} *13* α(N)=7.74×10^{-5} *11*; α(O)=1.086×10^{-5} *16*; α(P)=5.42×10^{-7} *8*
x381.03 *14*	12.6 *6*							
410.44 *17*	9.4 *7*	433.3	3/2+,5/2,7/2+	22.80	3/2+			
443.02 *24*	3.1 *5*	465.8		22.80	3/2+			
458.22 *16*	21.8 *8*	625.5		167.24	5/2+			
471.00 *10*	12.6 *7*	1180.70		709.66	5/2−			
519.12 *20*	4.8 *5*	678.08	5/2−	159.12	7/2+			
532.91 *23*	4.8 *7*	1180.70		647.89				
x536.6 *3*	3.3 *7*							
550.0 *5*	2.0 *6*	709.66	5/2−	159.12	7/2+			
x552.1 *5*	2.0 *6*							
x555.50 *15*	11.1 *6*							
560.48 *20*	16.2 *12*	638.74		78.20	7/2−			
x566.92 *22*	5.4 *7*							
569.73 *14*	43.2 *20*	647.89		78.20	7/2−			
599.88 *10*	198 *9*	678.08	5/2−	78.20	7/2−	M1(+E2)	0.017 *7*	α(K)=0.014 *6*; α(L)=0.0023 *7*; α(M)=0.00051 *14*; α(N+..)=0.00014 *4* α(N)=0.00012 *4*; α(O)=1.7×10^{-5} *5*; α(P)=8.E−7 *4*
631.45 *10*	106 *5*	709.66	5/2−	78.20	7/2−	M1(+E2)	0.015 *6*	α(K)=0.013 *5*; α(L)=0.0020 *6*; α(M)=0.00044 *13*; α(N+..)=0.00012 *4* α(N)=0.00010 *3*; α(O)=1.5×10^{-5} *5*; α(P)=7.E−7 *3*
x641.22 *21*	4.2 *5*							
x644.9 *4*	3.4 *7*							
659.10 *14*	24.6 *10*	678.08	5/2−	18.90	5/2+			
690.75 *20*	8.2 *7*	709.66	5/2−	18.90	5/2+			
x714.9 *4*	4.0 *7*							
x722.15 *23*	5.7 *8*							
x730.9 *5*	2.0 *7*							
x745.6 *4*	1.9 *5*							
x771.24 *28*	3.5 *6*							
x781.2 *3*	4.3 *8*							
x789.47 *27*	4.3 *5*							
x793.02 *23*	9.3 *6*							
x800.45 *28*	7.5 *10*							
x805.24 *24*	5.4 *6*							
x813.15 *28*	3.0 *4*							

$^{161}_{69}$Tm$_{92}$-4

^{161}Yb ε decay 1981Ad02 (continued)

$\gamma(^{161}Tm)$ (continued)

E_γ	I_γ †‡	E_i(level)
x816.5 *3*	2.3 *4*	
x823.5 *5*	1.8 *6*	
x842.7 *3*	4.5 *6*	
x959.6 *4*	3.2 *7*	
x1007.2 *4*	7.0 *8*	
x1018.5 *4*	6.2 *6*	

E_γ	I_γ †‡	E_i(level)	J^π_i	E_f	J^π_f
1022.0 *4*	3.9 *5*	1180.70		159.12	7/2$^+$
x1038.2 *5*	3.5 *6*				
x1042.7 *4*	7.7 *6*				
x1117.3 *5*	3.6 *9*				
x1145.6 *5*	7.3 *7*				
x1167.1 *6*	4.5 *7*				

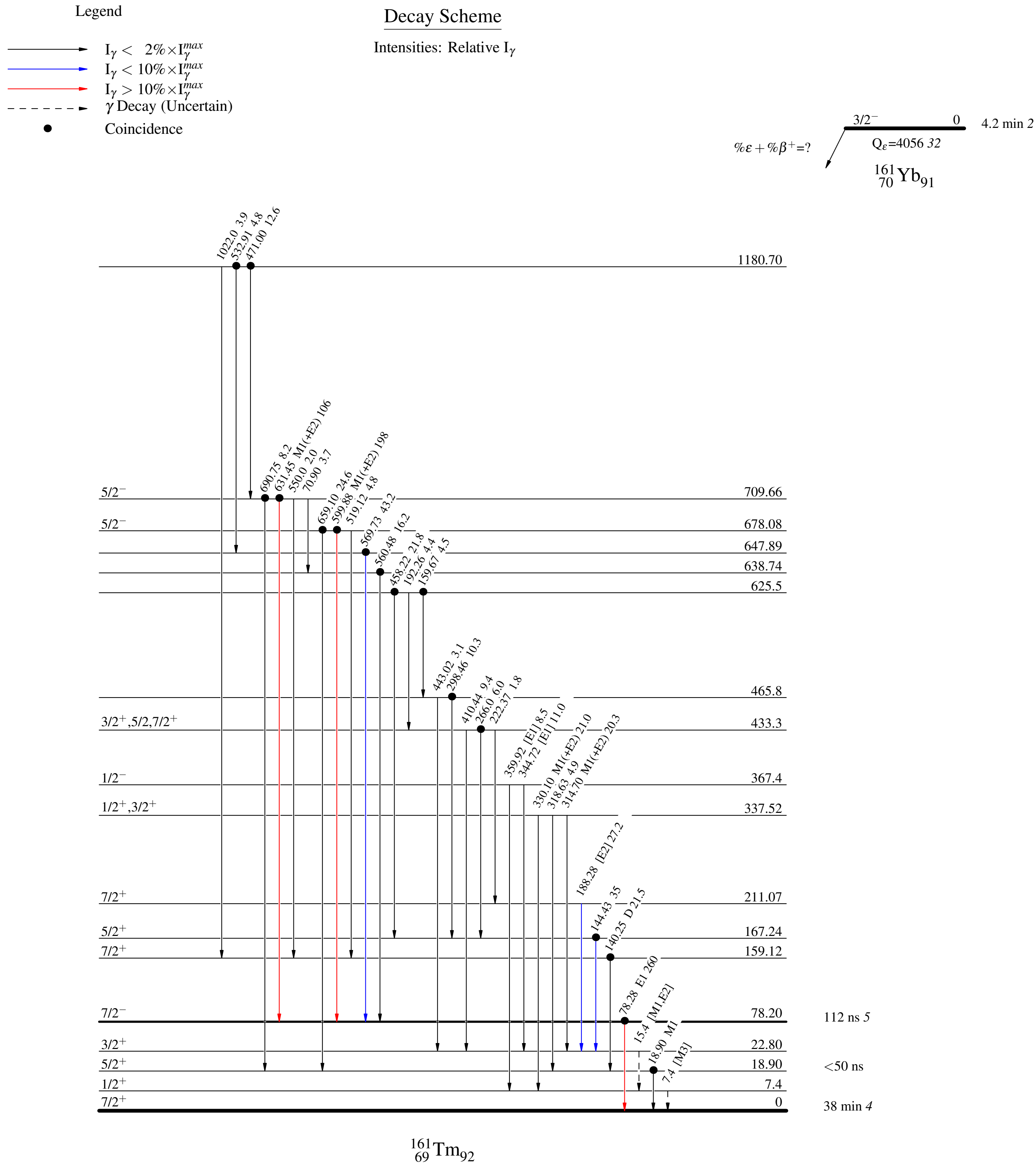
E_γ	I_γ †‡	E_i(level)
x1182.5 *5*	6.4 *7*	
x1364.9 *5*	7.3 *7*	
x1517.8 *5*	7.2 *9*	
x1805.8 *15*	4.6 *10*	

† $K\alpha_1$ x-ray intensity is 530 *40* (1974Ad10).
‡ Annihilation-radiation intensity is 222 *30* (1981Ad02).
# From ^{161}Tm Adopted Gammas and based on ce data from ^{161}Yb decay (1981Ad02) and $\gamma(\theta)$ from in-beam study (1984Fo04).
@ Additional information 6.
x γ ray not placed in level scheme.

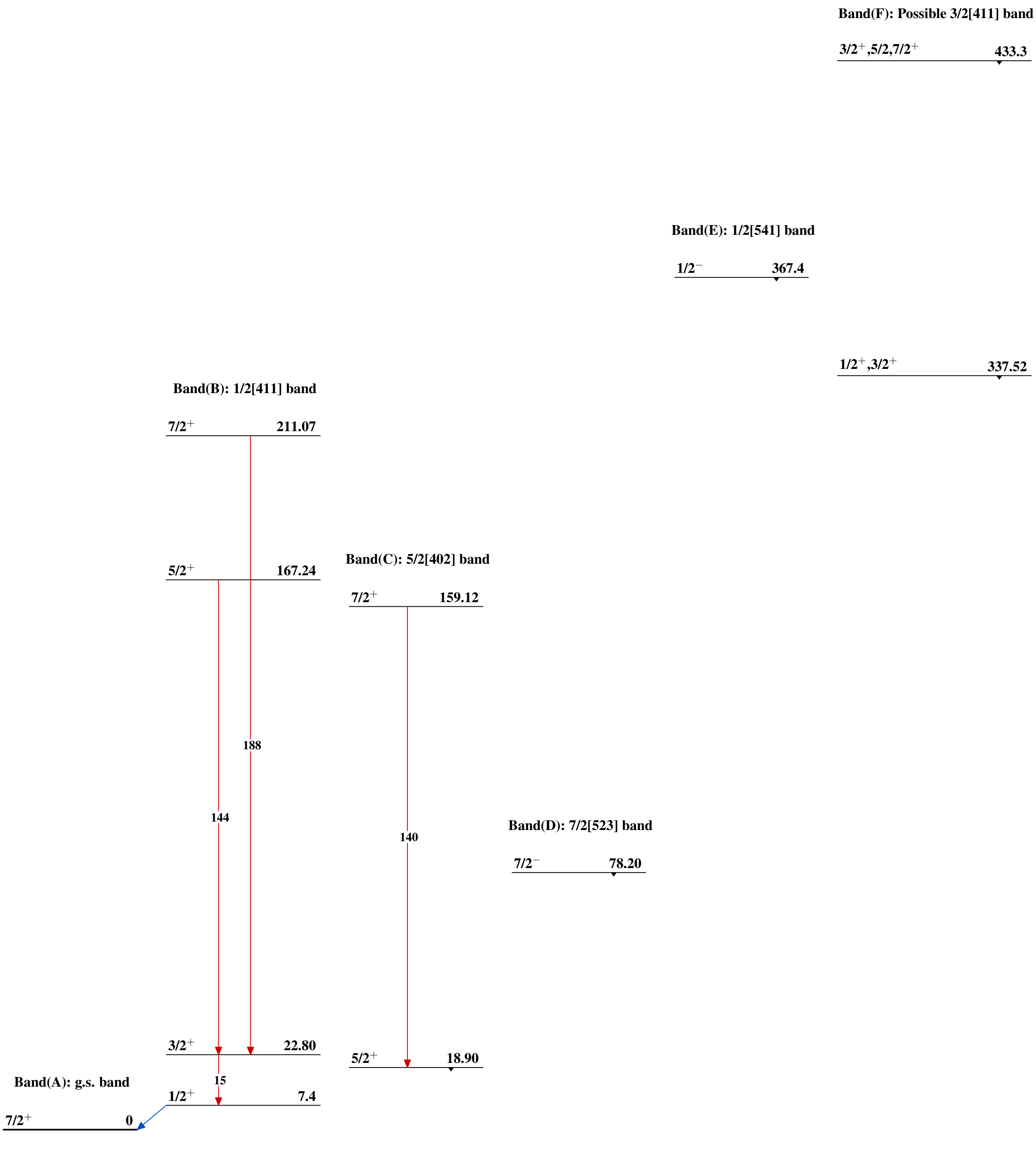
^{161}Yb ε decay 1981Ad02

Decay Scheme

Intensities: Relative I_γ



^{161}Yb ε decay 1981Ad02



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