^{162}**Yb $\varepsilon+\beta^+$ decay** **1982Ad03**

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	N. Nica	NDS 195,1 (2024)	19-Sep-2023

Parent: ^{162}Yb: E=0; J$^\pi$=0$^+$; $T_{1/2}$=18.87 min *19*; Q(ε)=1660 *30*; %ε+%β^+ decay=100
^{162}Yb-$T_{1/2}$: Additional information 1.
^{162}Yb-Q(ε): From 2021Wa16.
Additional information 2.
Data are from 1982Ad03 except as otherwise noted. Source produced by spallation of Ta and Hf targets with 660-MeV p with chemical and isotope separations. γ and ce singles and $\gamma\gamma$ and γe^- coincidences measured with Ge γ detectors and Si(Li), magnetic spectrographs and spectrometers for ce detectors.
2001AlZU studied the ^{162}Yb ε decay using a constant-field magnetic β spectrograph. They report ce lines from previously unreported γ's with energies of 66.93, 223.4, 245.7, 408.2, 415.8 and 672.5 keV but provide no other information about these γ's.

^{162}Tm Levels

Coincidence information in the plot is from 1982Ad03.

E(level)[†]	J$^\pi$[‡]	$T_{1/2}$[#@]	Comments
0.0[&]	1$^-$	21.70 min *19*	$T_{1/2}$: from ^{162}Tm Adopted Levels and based on 21.5 min *10* (1963Ab02), 22.5 min *10* (1969Pa16), 21.77 min *26* (1971Ch30), and 21.55 min *30* (1974DeZF).
44.651[&] *18*	2$^-$	1.44 ns *13*	$T_{1/2}$: weighted average of 1.55 ns *25* (1975AlYV) and 1.40 ns *15* (1978Sc10). Also: 1977AnZG.
163.351[a] *20*	1$^+$	1.1 ns *1*	$T_{1/2}$: from 1978Sc10. Other: <15 ns (1972Go34). Also: 1977AnZG.
290.30[a] *4*	2$^+$		
408.31 *10*			
415.88 *5*	1$^+$		
451.02 *6*			
739.45 *5*	1$^+$		
747.40 *7*	0$^+$,1$^+$,2$^+$,3$^+$		
754.93 *11*	0$^-$,1$^-$,2$^-$		
771.00 *6*	1$^+$		
780.20 *14*			
782.64 *7*	1$^+$		
791.82 *13*			
800.48 *8*			
815.75 *15*	0$^+$,1$^+$,2$^+$		
857.74 *15*			
901.40 *11*			
954.04 *11*	0$^-$,1$^-$,2$^-$		

† Computed from least-squares fit to the γ energies. The uncertainties may be underestimated since the reduced-χ^2 value is 2.6.
‡ From ^{162}Tm Adopted Levels, but determined primarily from this study.
\# For the excited levels from data from this decay mode only. See ^{162}Tm Adopted Levels for a summary of all such data.
@ Additional information 3.
& Band(A): K$^\pi$=1$^-$ band. Configuration=(ν 3/2[521])-(π 1/2[411]).
a Band(B): K$^\pi$=1$^+$ band. Configuration=(π 7/2[523])-(ν 5/2[523]).

^{162}Yb $\varepsilon+\beta^+$ decay 1982Ad03 (continued)

ε,β^+ radiations

E(decay)	E(level)	Iβ^+ ‡	Iε‡	Log *ft*	I($\varepsilon+\beta^+$)†‡	Comments
(706 *30*)	954.04		0.9 *1*	5.85 *7*	0.9 *1*	εK=0.8146 *11*; εL=0.1421 *8*; εM+=0.0433 *3*
(759 *30*)	901.40		0.8 *2*	5.97 *12*	0.8 *2*	εK=0.8162 *10*; εL=0.1409 *7*; εM+=0.04290 *25*
(802 *30*)	857.74		0.4 *1*	6.32 *12*	0.4 *1*	εK=0.8174 *8*; εL=0.1400 *6*; εM+=0.04258 *22*
(844 *30*)	815.75		0.4 *1*	6.37 *12*	0.4 *1*	εK=0.8185 *8*; εL=0.1392 *6*; εM+=0.04231 *19*
(860 *30*)	800.48		0.6 *1*	6.21 *8*	0.6 *1*	εK=0.8188 *7*; εL=0.1390 *6*; εM+=0.04222 *19*
(868 *30*)	791.82		0.3 *1*	6.52 *15*	0.3 *1*	εK=0.8190 *7*; εL=0.1388 *5*; εM+=0.04217 *18*
(877 *30*)	782.64		1.9 *3*	5.73 *8*	1.9 *3*	εK=0.8192 *7*; εL=0.1387 *5*; εM+=0.04211 *18*
(880 *30*)	780.20		0.9 *2*	6.06 *11*	0.9 *2*	εK=0.8193 *7*; εL=0.1386 *5*; εM+=0.04210 *18*
(889 *30*)	771.00		2.1 *4*	5.70 *9*	2.1 *4*	εK=0.8194 *7*; εL=0.1385 *5*; εM+=0.04205 *17*
(905 *30*)	754.93		0.4 *1*	6.44 *12*	0.4 *1*	εK=0.8198 *7*; εL=0.1383 *5*; εM+=0.04196 *17*
(913 *30*)	747.40		0.6 *1*	6.27 *8*	0.6 *1*	εK=0.8199 *6*; εL=0.1382 *5*; εM+=0.04193 *16*
(921 *30*)	739.45		3.3 *4*	5.53 *6*	3.3 *4*	εK=0.8201 *6*; εL=0.1380 *5*; εM+=0.04188 *16*
(1244 *30*)	415.88		1.7 *3*	6.10 *8*	1.7 *3*	εK=0.8245 *3*; εL=0.13471 *24*; εM+=0.04069 *9*
(1497 *30*)	163.351	0.11 *3*	73 *8*	4.63 *6*	73 *8*	av Eβ=230 *14*; εK=0.8254 *2*; εL=0.13297 *21*; εM+=0.04008 *7* Log *ft*: see 1989So01 for theoretical discussion of this β^+ transition.
(1660 *30*)	0.0	0.07 *5*	15 *10*	5.4 *3*	15 *10*	av Eβ=302 *14*; εK=0.8236 *7*; εL=0.13179 *25*; εM+=0.03968 *8* I($\varepsilon+\beta^+$): log *ft* systematics (1973Ra10) suggest that the log *ft* of this transition should be ≥5.9 or I($\varepsilon+\beta^+$)≤5%.

† Values are from γ-intensity balances and Iγ normalization and assume the decay scheme given is complete. The values of less than 1% may not be meaningful since there are unplaced γ's with intensities of up to 0.4%.
‡ Absolute intensity per 100 decays.

^{162}Yb ε+β^+ decay 1982Ad03 (continued)

γ(^{162}Tm)

Iγ normalization: From 1972Ch23 and 1975St12; based on total number of sample decays computed from intensity of K x-ray and 511-keV annihilation radiations.
Data are from 1982Ad03 except as otherwise noted.

E_γ[†]	I_γ[‡b]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[#]	δ[@a]	α[&]	Comments
44.65 2	7.6 3	44.651	2$^-$	0.0	1$^-$	M1+E2	0.28 3	11.9 14	%Iγ=3.04 33 α(L)=9.2 11; α(M)=2.2 3 α(N)=0.49 6; α(O)=0.062 7; α(P)=0.00157 3
118.70 2	84 4	163.351	1$^+$	44.651	2$^-$	E1		0.212	%Iγ=34 4 α(K)=0.1763 25; α(L)=0.0279 4; α(M)=0.00620 9 α(N)=0.001426 20; α(O)=0.000191 3; α(P)=8.05$\times10^{-6}$ 12
125.58 3	1.97 21	415.88	1$^+$	290.30	2$^+$	E2(+M1)		1.47 16	%Iγ=0.79 12 α(K)=0.98 38; α(L)=0.38 18; α(M)=0.090 44 α(N)=0.0205 99; α(O)=0.0026 11; α(P)=5.4$\times10^{-5}$ 29
126.78 10	1.2 3	290.30	2$^+$	163.351	1$^+$	M1(+E2)		1.42 16	%Iγ=0.48 13 α(K)=0.95 37; α(L)=0.36 17; α(M)=0.086 42 α(N)=0.0198 94; α(O)=0.00246 97; α(P)=5.3$\times10^{-5}$ 28
163.35 3	100 4	163.351	1$^+$	0.0	1$^-$	E1		0.0911	%Iγ=40 4 α(K)=0.0762 11; α(L)=0.01164 17; α(M)=0.00259 4 α(N)=0.000597 9; α(O)=8.13$\times10^{-5}$ 12; α(P)=3.64$\times10^{-6}$ 5
183.05 22	1.13 13	954.04	0$^-$,1$^-$,2$^-$	771.00	1$^+$	E1		0.0676	%Iγ=0.45 7 α(K)=0.0566 9; α(L)=0.00856 13; α(M)=0.00190 3 α(N)=0.000439 7; α(O)=6.02$\times10^{-5}$ 9; α(P)=2.75$\times10^{-6}$ 4
[x]184.9 4	0.77 21					E1		0.0659	%Iγ=0.31 9 α(K)=0.0552 9; α(L)=0.00833 13; α(M)=0.00185 3 α(N)=0.000428 7; α(O)=5.86$\times10^{-5}$ 9; α(P)=2.68$\times10^{-6}$ 4
[x]194.64 9	0.48 5								%Iγ=0.192 28
206.82 12	0.72 7	954.04	0$^-$,1$^-$,2$^-$	747.40	0$^+$,1$^+$,2$^+$,3$^+$	E1		0.0492	%Iγ=0.29 4 α(K)=0.0413 6; α(L)=0.00618 9; α(M)=0.001372 20 α(N)=0.000317 5; α(O)=4.37$\times10^{-5}$ 7; α(P)=2.03$\times10^{-6}$ 3
[x]210.68 8	1.04 10					E1		0.0469	%Iγ=0.42 6 α(K)=0.0394 6; α(L)=0.00589 9; α(M)=0.001306 19 α(N)=0.000302 5; α(O)=4.16$\times10^{-5}$ 6; α(P)=1.94$\times10^{-6}$ 3
[x]217.52 7	0.50 10								%Iγ=0.20 4
244.83 10	0.56 10	408.31		163.351	1$^+$				%Iγ=0.22 5
290.35 4	0.96 10	290.30	2$^+$	0.0	1$^-$	E1		0.0208	%Iγ=0.38 6 α(K)=0.01755 25; α(L)=0.00256 4; α(M)=0.000568 8 α(N)=0.0001318 19; α(O)=1.84$\times10^{-5}$ 3; α(P)=8.95$\times10^{-7}$ 13
329.3 3	0.6 3	780.20		451.02					%Iγ=0.24 12

$^{162}_{69}Tm_{93}$-3

γ(^{162}Tm) (continued)

E_γ[†]	I_γ[‡b]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	α[&]	Comments
^{x}335.02 *8*	0.72 *10*					M1(+E2)	0.080 *29*	%Iγ=0.29 *5* α(K)=0.064 *27*; α(L)=0.0118 *16*; α(M)=0.0027 *3* α(N)=0.00063 *8*; α(O)=8.6×10^{-5} *15*; α(P)=3.7×10^{-6} *18*
349.44 *7*	1.04 *10*	800.48		451.02		E1	0.01327	%Iγ=0.42 *6* α(K)=0.01120 *16*; α(L)=0.001617 *23*; α(M)=0.000358 *5* α(N)=8.32×10^{-5} *12*; α(O)=1.166×10^{-5} *17*; α(P)=5.80×10^{-7} *9*
^{x}353.57 *17*	0.24 *10*							%Iγ=0.10 *4*
^{x}357.14 *13*	0.32 *10*					E2	0.0427	%Iγ=0.13 *4* α(K)=0.0321 *5*; α(L)=0.00820 *12*; α(M)=0.00192 *3* α(N)=0.000442 *7*; α(O)=5.72×10^{-5} *8*; α(P)=1.696×10^{-6} *24*
^{x}365.93 *23*	0.16 *10*							%Iγ=0.06 *4*
^{x}372.77 *12*	0.48 *10*							%Iγ=0.19 *4*
384.85 *24*	0.24 *10*	800.48		415.88	1$^+$			%Iγ=0.10 *4*
399.86 *14*	0.40 *10*	815.75	0$^+$,1$^+$,2$^+$	415.88	1$^+$	M1	0.0676	%Iγ=0.16 *4* α(K)=0.0569 *8*; α(L)=0.00837 *12*; α(M)=0.00186 *3* α(N)=0.000435 *7*; α(O)=6.27×10^{-5} *9*; α(P)=3.43×10^{-6} *5*
406.39 *6*	0.80 *10*	451.02		44.651	2$^-$			%Iγ=0.32 *5*
^{x}425.40 *10*	0.56 *10*							%Iγ=0.22 *5*
450.69 *18*	0.56 *10*	451.02		0.0	1$^-$			%Iγ=0.22 *5*
457.38 *19*	0.72 *10*	747.40	0$^+$,1$^+$,2$^+$,3$^+$	290.30	2$^+$			%Iγ=0.29 *5*
^{x}540.04 *9*	0.56 *10*							%Iγ=0.22 *5*
545.40 *16*	0.32 *10*	954.04	0$^-$,1$^-$,2$^-$	408.31				%Iγ=0.13 *4*
^{x}550.86 *19*	0.32 *10*							%Iγ=0.13 *4*
576.10 *4*	8.1 *5*	739.45	1$^+$	163.351	1$^+$	M1(+E2)	0.0192 *72*	%Iγ=3.2 *4* α(K)=0.0159 *63*; α(L)=0.00253 *70*; α(M)=5.7×10^{-4} *15* α(N)=1.32×10^{-4} *36*; α(O)=1.87×10^{-5} *55*; α(P)=9.3×10^{-7} *40*
584.07 *7*	1.60 *20*	747.40	0$^+$,1$^+$,2$^+$,3$^+$	163.351	1$^+$	E2	0.01163	%Iγ=0.64 *10* α(K)=0.00936 *14*; α(L)=0.001763 *25*; α(M)=0.000402 *6* α(N)=9.32×10^{-5} *13*; α(O)=1.267×10^{-5} *18*; α(P)=5.22×10^{-7} *8*
591.58 *10*	1.12 *20*	754.93	0$^-$,1$^-$,2$^-$	163.351	1$^+$	E1	0.00405	%Iγ=0.45 *9* α(K)=0.00343 *5*; α(L)=0.000480 *7*; α(M)=0.0001059 *15* α(N)=2.47×10^{-5} *4*; α(O)=3.50×10^{-6} *5*; α(P)=1.84×10^{-7} *3*
607.68 *5*	5.7 *6*	771.00	1$^+$	163.351	1$^+$	E2	0.01058	%Iγ=2.28 *33* α(K)=0.00854 *12*; α(L)=0.001579 *23*; α(M)=0.000359 *5* α(N)=8.34×10^{-5} *12*; α(O)=1.137×10^{-5} *16*; α(P)=4.77×10^{-7} *7*
616.84 *10*	1.7 *3*	780.20		163.351	1$^+$			%Iγ=0.68 *14*
619.55 *15*	2.2 *4*	782.64	1$^+$	163.351	1$^+$	E2	0.01010	%Iγ=0.88 *18* α(K)=0.00817 *12*; α(L)=0.001497 *21*; α(M)=0.000341 *5* α(N)=7.90×10^{-5} *11*; α(O)=1.079×10^{-5} *16*; α(P)=4.57×10^{-7} *7*
628.47 *12*	0.72 *10*	791.82		163.351	1$^+$			%Iγ=0.29 *5*
637.13 *20*	0.24 *10*	800.48		163.351	1$^+$			%Iγ=0.10 *4*

γ(^{162}Tm) (continued)

E_γ [†]	I_γ [‡b]	E_i(level)	J^π_i	E_f	J^π_f	Comments
652.5 *5*	0.50 *20*	815.75	$0^+,1^+,2^+$	163.351	1^+	%Iγ=0.20 *8*
694.39 *14*	1.04 *10*	857.74		163.351	1^+	%Iγ=0.42 *6*
725.96 *18*	0.64 *10*	771.00	1^+	44.651	2^-	%Iγ=0.26 *5*
[x]730.71 *20*	0.48 *10*					%Iγ=0.19 *4*
738.07[c] *13*	1.8[c] *4*	782.64	1^+	44.651	2^-	%Iγ=0.72 *18*
738.07[c] *13*	1.8[c] *4*	901.40		163.351	1^+	%Iγ=0.72 *18*
[x]774.31 *10*	0.88 *10*					%Iγ=0.35 *5*
782.47 *10*	0.76 *10*	782.64	1^+	0.0	1^-	%Iγ=0.30 *5*
856.71 *18*	0.32 *10*	901.40		44.651	2^-	%Iγ=0.13 *4*

[†] The uncertainties may be underestimated since the fit of the level energies has a reduced-χ^2 value of 2.6.

[‡] I(K x)=250 *18*.

[#] From 1982Ad03 and based on L subshell ratios and α(K)exp values. For γ's of 44, 118, and 163 keV, the same assignments are made by 1969Pa16, 1972Ch23, 1972Go34, and 1975St12.

[@] From 1982Ad03 with similar values given by 1975St12 and 1972Go34.

[&] Additional information 4.

[a] If No value given it was assumed δ=1.00 for E2/M1, δ=1.00 for E3/M2 and δ=0.10 for the other multipolarities.

[b] For absolute intensity per 100 decays, multiply by 0.40 *4*.

[c] Multiply placed with undivided intensity.

[x] γ ray not placed in level scheme.

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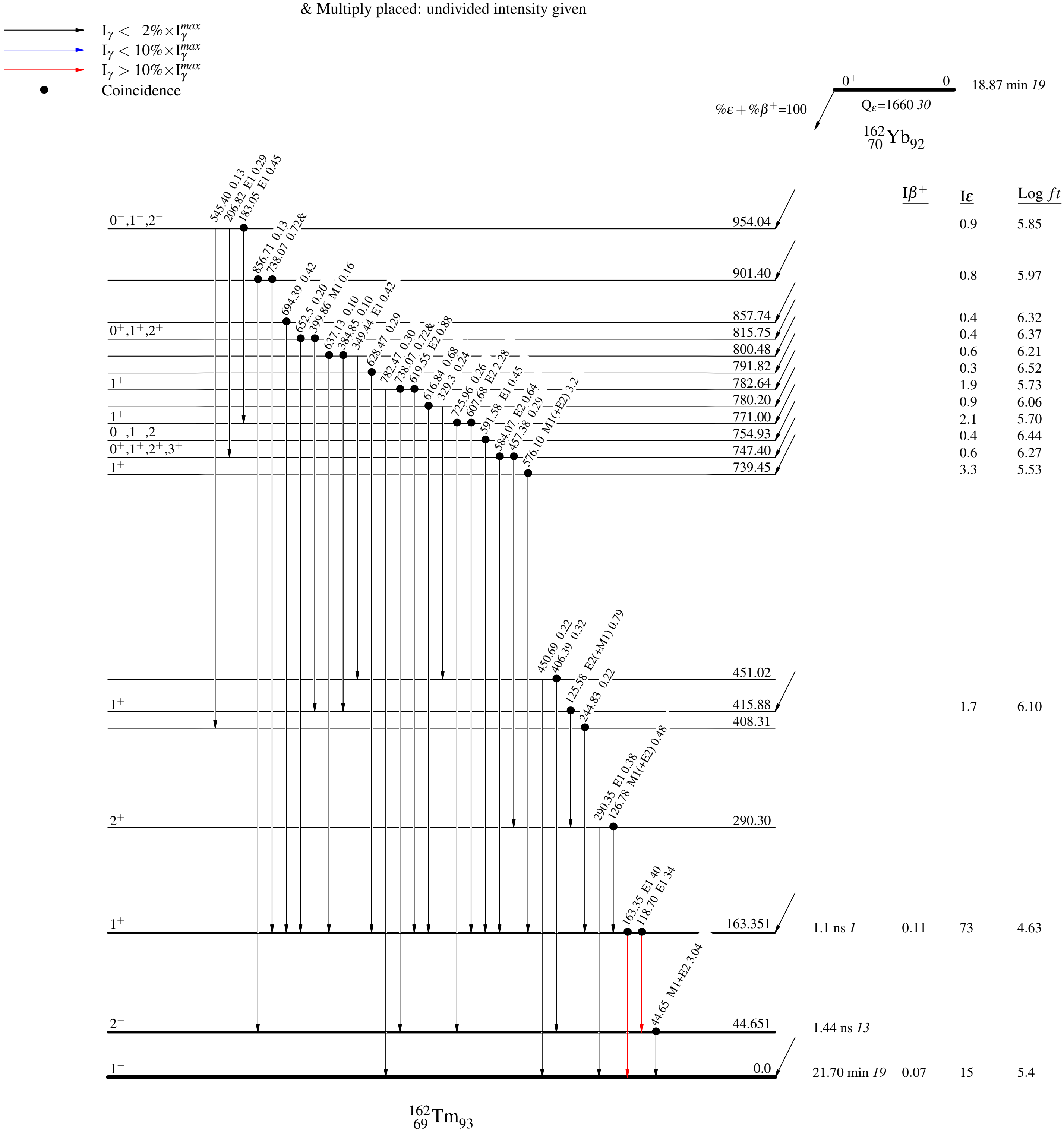
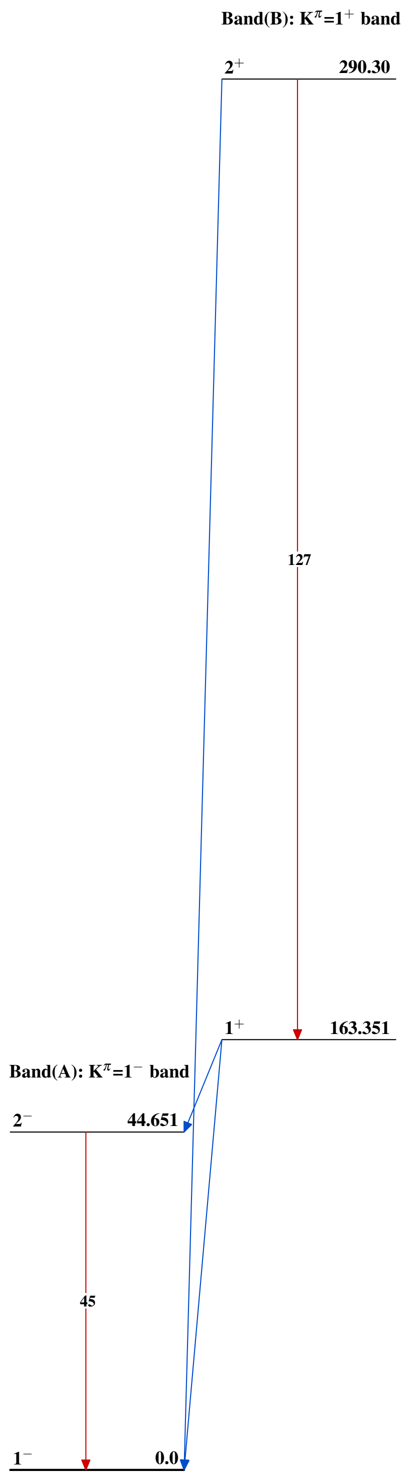
Decay Scheme

Intensities: I_γ per 100 parent decays
& Multiply placed: undivided intensity given



^{162}Yb ε decay 1982Ad03



$^{162}_{69}Tm_{93}$