^{130}Te(^{40}Ar,5nγ) 1987Be07,1979Ri06,1974Ri12

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh and Jun Chen	NDS 194,460 (2024)	31-Oct-2022

Includes reactions: ^{154}Sm(^{16}O,5nγ) (1979Ri06); ^{148}Nd(^{22}Ne,5nγ) and ^{156}Gd(^{12}C,3nγ) (1974Ri12); ^{169}Tm(p,5nγ) (1971IsZV).

1987Be07: ^{130}Te(^{40}Ar,5nγ),E=180 MeV. Measured Eγ, Iγ, $\gamma\gamma$-coin, $\gamma(\theta)$ using the HERA array of 20 Compton-suppressed Ge detectors at the 88-inch cyclotron of the Lawrence Berkeley National Laboratory.

1979Ri06 (also 1977Ri13): ^{154}Sm(^{16}O,5nγ),E=85-95 MeV. Measured Eγ, Iγ, ce, $\gamma\gamma$-coin, ce-γ-coin, level half-lives by ce(t), $\gamma(\theta)$, excitation functions using solenoid-Si(Li) spectrometer and Ge(Li) detectors at the tandem accelerator of MPI, Heidelberg. Two bands reported: $\nu h_{9/2}$ band from 5/2$^-$ to 45/2$^-$ (γ cascade of 13 transitions); $\nu i_{13/2}$ band from 9/2$^+$ to 45/2$^+$ (γ cascade of 21 transitions). Details of γ-ray data are not given by 1979Ri06.

1974Ri12: ^{148}Nd(^{22}Ne,5nγ),E=109 MeV, ^{156}Gd(^{12}C,3nγ),E=58 MeV. Measured Eγ, Iγ, $\gamma\gamma$-coin, $\gamma(\theta)$, excitation functions using two Ge(Li) detectors using isochronous cyclotron facility at ORNL. Two bands reported: $\nu h_{9/2}$ band from 3/2$^-$ to 45/2$^-$ (13 transitions); $\nu i_{13/2}$ band from 9/2$^+$ to 41/2$^+$ (18 transitions). Details of γ-ray data are not given by 1974Ri12. A 61γ reported by 1974Ri12 from a 171, 5/2$^-$ level is not confirmed in any other study.

1971IsZV: ^{169}Tm(p,5nγ),E=52 MeV. A total of ten tentative γ rays reported, only four of these confirmed in later studies.

Others:

2001Bu11: ^{124}Sn(^{48}Ca,7n),E=215 MeV. Measured ce, (recoil)ce coin; lines identified at 80, 140, 195 and 250 using the GREAT spectrometer at the University of Jyvaskyla accelerator facility.

1985In03, 1979In03: ^{159}Tb(^{14}N,α4n),E=115, 95 MeV: measured γ-multiplicity.

1983De02: ^{130}Te(^{40}Ar,5n),E=185 MeV. Measured total γ spectra.

Additional information 1.

^{165}Yb Levels

Nomenclature for quasi-particle orbitals:
A: ν5/2[642], α=+1/2.
B: ν5/2[642], α=−1/2.
C: ν3/2[651], α=+1/2.
D: ν3/2[651], α=−1/2.
E: ν5/2[523], α=+1/2.
F: ν5/2[523], α=−1/2.

E(level)[†]	J$^\pi$[@]	T$_{1/2}$[#]	Comments
0.0[c]	5/2$^-$		
87.45 *16*	7/2$^-$		
126.61[&] *23*	9/2$^+$		J$^\pi$: 1974Ri12 assign 9/2$^+$ to this level as the bandhead based on similarity of transitions in this band to those in the yrast cascade of ^{161}Er with 9/2$^+$ for the bandhead.
131.8[‡] *4*	7/2$^+$		
197.45[c] *16*	9/2$^-$	0.179 ns *5*	E(level): in 1974Ri12, this level is shown to decay to the ground state by 197.5γ-61γ-109.8γ cascade, thus pushing the energy of this level upwards to 369 keV. In none of the other studies, the 61-keV transition is reported, thus defining the energy of the 9/2$^-$ at 197 keV and this level decaying directly to the ground state.
209.55[a] *25*	11/2$^+$	1.5 ns *2*	T$_{1/2}$: average of 1.7 ns *2* and 1.3 ns *2* (1979Ri06).
216.8[&] *3*	13/2$^+$	1.26 ns *15*	
330.4?[‡] *11*	11/2$^-$		
419.1[a] *3*	15/2$^+$		
422.7[&] *4*	17/2$^+$	0.109 ns *9*	
484.49[c] *23*	13/2$^-$		
745.0[&] *4*	21/2$^+$		
757.9[a] *4*	19/2$^+$		

Continued on next page (footnotes at end of table)

^{130}Te(^{40}Ar,5nγ) 1987Be07,1979Ri06,1974Ri12 (continued)

^{165}Yb Levels (continued)

E(level)†	Jπ@	E(level)†	Jπ@	E(level)†	Jπ@	E(level)†	Jπ@
850.2[c] 3	17/2−	2978.0[&] 5	37/2+	4860.8[d] 6	47/2−	7729.6[c] 7	61/2−
1173.9[&] 4	25/2+	3084.9[a] 5	35/2+	5169.7[b] 8	49/2+	7844.7[b] 8	61/2+
1211.0[a] 4	23/2+	3243.0[c] 5	37/2−	5188.4[c] 6	49/2−	8055.7?[&] 13	(61/2+)
1280.7[c] 4	21/2−	3325.0[b] 9	(37/2+)	5353.4[&] 8	(49/2+)	8343.3[d] 7	63/2−
1697.5[&] 5	29/2+	3519.7[d] 5	39/2−	5473.3[a] 13	(47/2+)	8704.4[c] 8	65/2−
1758.4[c] 4	25/2−	3706.4[&] 7	41/2+	5634.0[d] 6	51/2−	8865.1[b] 9	65/2+
1760.4[a] 4	27/2+	3823.8[c] 6	41/2−	5970.2[c] 7	53/2−	9367.7[d] 9	67/2−
1978.4[d] 5	27/2−	3834.3[a] 5	39/2+	5984.8[b] 8	53/2+	9734.4[c] 8	69/2−
2248.7[c] 4	29/2−	3858.0[b] 8	(41/2+)	6217.7[&] 8	(53/2+)	9923.2[b] 10	(69/2+)
2303.0[&] 5	33/2+	4155.1[d] 6	43/2−	6472.7[d] 7	55/2−	10794.5[c] 9	73/2−
2389.7[a] 5	31/2+	4434.8[b] 7	45/2+	6817.2[c] 7	57/2−	11847.5?[c] 14	(77/2−)
2447.8[d] 5	31/2−	4472.7[c] 6	45/2−	6880.1[b] 8	57/2+		
2726.3[c] 5	33/2−	4538.0[&] 7	45/2+	7118.7[&] 8	(57/2+)		
2953.6[d] 5	35/2−	4622.3[a] 7	(43/2+)	7376.7[d] 7	59/2−		

† From least-squares fit to Eγ data.
‡ From 1979Ri06 only in ^{154}Sm(^{16}O,5nγ).
# From ce(t) in ^{154}Sm(^{16}O,5nγ) (1979Ri06).
@ As proposed by 1987Be07, based on γ(θ) data and band assignments. These assignments are in agreement with those in the Adopted Levels, except that some are in parentheses there due to insufficient strong supporting arguments.
& Band(A): ν5/2[642] or A, α+1/2. ABC band crosses this band at ħω≈0.36 MeV in the spin range 41/2-45/2.
[a] Band(a): ν5/2[642] or B, α=−1/2. Since this band is populated weakly at higher spins, no information is available about alignments.
[b] Band(B): ABC, α=+1/2. Band ABC crosses A at ħω≈0.36 MeV in the spin range 41/2-45/2.
[c] Band(C): ν5/2[523] or E, α=+1/2. EAB band crosses this band at ħω≈0.23 MeV in the spin range 29/2-33/2. Note that energies in this band are higher by 171 keV in 1974Ri12, as these authors reported decay of the 197, 9/2− level through a 61γ-109.8γ cascade to the 5/2− g.s., whereas all the other high-spin studies reported decay of the 197, 9/2− level directly to the 5/2− g.s.
[d] Band(D): FAB, α=−1/2. Band built on F orbital is observed only above the AB alignment.

^{130}Te(^{40}Ar,5nγ) 1987Be07,1979Ri06,1974Ri12 (continued)

$\gamma(^{165}Yb)$

R(asym)=Iγ(90°)/Iγ(40°), obtained from $\gamma\gamma$ coin spectra and normalized to 322.2γ, ΔJ=2, E2 transition. R(asym)=1 for ΔJ=2, stretched quadrupole and ≈2 for ΔJ=1, dipole (1987Be07).

The cascade 430-490-517-478-478-581 reported in 1974Ri12 and 1979Ri06 is reordered as 430-478-490-478-517-581 in 1987Be07, 1984Sc23 and 1982Ro08; the latter ordering is adopted by the evaluators.

E_γ [†]	I_γ [‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[b]	δ	α[e]	Comments
39.2[&] *2*		126.61	9/2$^+$	87.45	7/2$^-$				
77.8[a] *2*		209.55	11/2$^+$	131.8	7/2$^+$	(E2)		8.67 *16*	K/L=0.5 *1* (1979Ri06) K/L ratio for 77.8γ and 78.3γ in ^{163}Yb; δ(E2/M1)=2.8 *+8−4*, however, ΔJ^π requires E2.
83.0[&] *2*		209.55	11/2$^+$	126.61	9/2$^+$	M1+E2	0.82 *4*	6.13 *11*	K/L=1.7 *1* (1979Ri06) δ(E2/M1)=0.75 *4* (1979Ri06). BrIccMixing gives δ=0.82 *4*.
87.5[&] *2*		87.45	7/2$^-$	0.0	5/2$^-$	E2+M1	1.10 *+8−7*	5.19 *8*	K/L=1.3 *1* (1979Ri06) δ(E2/M1)=1.05 *7* (1979Ri06). Using Eγ=87.54 *6* from the Adopted Gammas, and BrIccMixing, δ(E2/M1)=1.10 *+8−7*.
90.2[&] *2*		216.8	13/2$^+$	126.61	9/2$^+$	(E2)[c]		4.79 *8*	K/L=0.47 *5* (1979Ri06) δ(E2/M1)>6.6 (1979Ri06), >4 from BrIccMixing; ΔJ requires E2.
110.0[&] *2*		197.45	9/2$^-$	87.45	7/2$^-$	D[d]			E_γ: 1974Ri12 place this γ in a cascade of 197.5γ-61γ-109.8γ to ground state with no observed coincidence data.
133[ag]		330.4?	11/2$^-$	197.45	9/2$^-$				
197.4 *2*	12.8 *13*	197.45	9/2$^-$	0.0	5/2$^-$	E2[c]		0.281 *4*	R(asym)=1.06 *9*.
202.5[#] *5*	10.1[#] *10*	419.1	15/2$^+$	216.8	13/2$^+$	D[d]			R(asym)=1.4 *2*.
205.8 *2*	84 *8*	422.7	17/2$^+$	216.8	13/2$^+$	E2[c]		0.244 *4*	R(asym)=1.13 *6*.
209.6 *2*	20 *2*	419.1	15/2$^+$	209.55	11/2$^+$	Q[c]			R(asym)=0.84 *12*.
275.0 *2*	2.2 *2*	484.49	13/2$^-$	209.55	11/2$^+$				
287.0 *2*	20 *2*	484.49	13/2$^-$	197.45	9/2$^-$	Q[c]			R(asym)=1.14 *10*.
322.2 *2*	100	745.0	21/2$^+$	422.7	17/2$^+$	[c]			R(asym)=1.0 (used for normalization).
335.3 *2*	6.4 *6*	757.9	19/2$^+$	422.7	17/2$^+$	D[d]			R(asym)=1.9 *5*.
338		2726.3	33/2$^-$	2389.7	31/2$^+$				
339.0 *5*	[@]	757.9	19/2$^+$	419.1	15/2$^+$	Q[c]			R(asym)=0.83 *10*.
365.7 *2*	19.4 *20*	850.2	17/2$^-$	484.49	13/2$^-$	Q[c]			R(asym)=1.09 *10*.
429.2 *2*	92 *9*	1173.9	25/2$^+$	745.0	21/2$^+$	Q[c]			R(asym)=0.97 *5*.
430.6 *5*	[@]	1280.7	21/2$^-$	850.2	17/2$^-$	Q			R(asym)=1.15 *10*.
431[g] *1*	[@]	850.2	17/2$^-$	419.1	15/2$^+$				
453.2 *2*	23 *2*	1211.0	23/2$^+$	757.9	19/2$^+$	Q[c]			R(asym)=0.83 *8*.
465.7 *2*	4.4 *4*	1211.0	23/2$^+$	745.0	21/2$^+$	D[d]			R(asym)=1.3 *3*.
469.3 *2*	4.0 *4*	2447.8	31/2$^-$	1978.4	27/2$^-$	Q			R(asym)=0.89 *18*.

$^{165}_{70}Yb_{95}$-3

^{130}Te(^{40}Ar,5nγ) 1987Be07,1979Ri06,1974Ri12 (continued)

$\gamma(^{165}Yb)$ (continued)

E_γ[†]	I_γ[‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[b]	Comments
477.6[f] 2	56[f] 6	1758.4	25/2$^-$	1280.7	21/2$^-$	Q	R(asym)=0.99 8.
477.6[f] 2	56[f] 6	2726.3	33/2$^-$	2248.7	29/2$^-$	Q[c]	R(asym)=0.99 8.
488.5 5	[@]	2248.7	29/2$^-$	1760.4	27/2$^+$		
490.2 2	29 3	2248.7	29/2$^-$	1758.4	25/2$^-$	Q[c]	R(asym)=1.11 9.
505.9 2	10.7 11	2953.6	35/2$^-$	2447.8	31/2$^-$	Q	R(asym)=1.01 14.
516.7 2	28 3	3243.0	37/2$^-$	2726.3	33/2$^-$	Q[c]	R(asym)=0.97 8.
522.7 2	3.4 4	1280.7	21/2$^-$	757.9	19/2$^+$	D	R(asym)=2.0 6.
523.6 2	79 8	1697.5	29/2$^+$	1173.9	25/2$^+$	Q[c]	R(asym)=0.90 5.
533 1	[@]	3858.0	(41/2$^+$)	3325.0	(37/2$^+$)		
542.0[#] 5	4.1[#] 4	3519.7	39/2$^-$	2978.0	37/2$^+$		
547.2 5	1.9 2	1758.4	25/2$^-$	1211.0	23/2$^+$	D	R(asym)=2.1 5.
549.3 2	23 2	1760.4	27/2$^+$	1211.0	23/2$^+$	Q[c]	R(asym)=0.94 13.
566.1 2	17.8 18	3519.7	39/2$^-$	2953.6	35/2$^-$	Q	R(asym)=0.70 10.
577 1	1.0 5	4434.8	45/2$^+$	3858.0	(41/2$^+$)	Q	R(asym)=1.0 3.
580.8 2	25 3	3823.8	41/2$^-$	3243.0	37/2$^-$	Q[c]	R(asym)=1.03 12.
586.8 2	6.1 6	1760.4	27/2$^+$	1173.9	25/2$^+$	D[d]	R(asym)=1.6 2.
605.5 2	66 7	2303.0	33/2$^+$	1697.5	29/2$^+$	Q[c]	R(asym)=0.97 5.
629.3 2	10.6 11	2389.7	31/2$^+$	1760.4	27/2$^+$	Q[c]	R(asym)=0.93 13.
635.3 2	14.1 15	4155.1	43/2$^-$	3519.7	39/2$^-$	Q	R(asym)=0.75 11.
648.9 2	21 2	4472.7	45/2$^-$	3823.8	41/2$^-$	Q	R(asym)=0.97 11.
650.5 2	10.7 11	2953.6	35/2$^-$	2303.0	33/2$^+$	D	R(asym)=1.5 2.
675.0 2	45 4	2978.0	37/2$^+$	2303.0	33/2$^+$	Q[c]	R(asym)=1.00 8.
680 1	4.1 4	4538.0	45/2$^+$	3858.0	(41/2$^+$)	Q	R(asym)=0.78 11.
695.2 2	6.3 6	3084.9	35/2$^+$	2389.7	31/2$^+$	Q	R(asym)=0.63 19.
705.7 2	10.0 10	4860.8	47/2$^-$	4155.1	43/2$^-$	Q	R(asym)=1.03 13.
715.7 2	16.2 16	5188.4	49/2$^-$	4472.7	45/2$^-$	Q	R(asym)=0.81 10. Uncertainty of 0 on R(asym) seems a misprint. The evaluators have assigned 0.10.
728.4[f] 5	41[f] 4	3706.4	41/2$^+$	2978.0	37/2$^+$	Q[c]	R(asym)=0.90 7.
728.4[f] 2	41[f] 4	4434.8	45/2$^+$	3706.4	41/2$^+$	Q	R(asym)=0.90 7.
734.9 2	11 1	5169.7	49/2$^+$	4434.8	45/2$^+$	Q	R(asym)=0.95 12.
749.4 2	3.9 4	3834.3	39/2$^+$	3084.9	35/2$^+$	Q	R(asym)=0.7 2.
750.4 2	9.9 10	2447.8	31/2$^-$	1697.5	29/2$^+$	D	R(asym)=1.5 3.
773.2 2	8.2 8	5634.0	51/2$^-$	4860.8	47/2$^-$	Q	R(asym)=0.88 12.
781.8 2	10.6 11	5970.2	53/2$^-$	5188.4	49/2$^-$	Q	R(asym)=0.77 11.
788.0 5	1.7 5	4622.3	(43/2$^+$)	3834.3	39/2$^+$		
804.2[#] 5	4.9[#] 5	1978.4	27/2$^-$	1173.9	25/2$^+$	D	R(asym)=1.7 5.
815.1 2	7.5 8	5984.8	53/2$^+$	5169.7	49/2$^+$	Q	R(asym)=1.11 15.
815.4 2	5.5 6	5353.4	(49/2$^+$)	4538.0	45/2$^+$	(Q)	R(asym)=1.4 4.
831.6 2	7.0 7	4538.0	45/2$^+$	3706.4	41/2$^+$	Q	R(asym)=0.84 17.

$^{165}_{70}Yb_{95}$-4

^{130}Te(^{40}Ar,5nγ) 1987Be07,1979Ri06,1974Ri12 (continued)

$\gamma(^{165}Yb)$ (continued)

E_γ[†]	I_γ[‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[b]	Comments
838.7 *2*	5.0 *5*	6472.7	55/2$^-$	5634.0	51/2$^-$	Q	R(asym)=1.23 *17*.
847.0 *2*	7.7 *8*	6817.2	57/2$^-$	5970.2	53/2$^-$	Q	R(asym)=1.03 *18*.
851[g] *1*	<1	5473.3	(47/2$^+$)	4622.3	(43/2$^+$)		
864.3 *2*	3.6 *4*	6217.7	(53/2$^+$)	5353.4	(49/2$^+$)	Q	R(asym)=0.9 *3*.
880 *1*	3.1 *6*	3858.0	(41/2$^+$)	2978.0	37/2$^+$		
895.3 *2*	4.6 *5*	6880.1	57/2$^+$	5984.8	53/2$^+$	Q	R(asym)=0.77 *14*.
901.0 *2*	1.6 *8*	7118.7	(57/2$^+$)	6217.7	(53/2$^+$)	Q	R(asym)=0.77 *19*.
904.0 *2*	4.0 *4*	7376.7	59/2$^-$	6472.7	55/2$^-$	Q	R(asym)=1.1 *2*.
912.4 *2*	4.5 *5*	7729.6	61/2$^-$	6817.2	57/2$^-$	Q	R(asym)=0.82 *18*.
937[g] *1*	1.0 *5*	8055.7?	(61/2$^+$)	7118.7	(57/2$^+$)	Q	R(asym)=0.8 *3*.
964.6 *2*	3.8 *4*	7844.7	61/2$^+$	6880.1	57/2$^+$	Q	R(asym)=0.77 *17*.
966.6 *2*	2.0 *5*	8343.3	63/2$^-$	7376.7	59/2$^-$	Q	R(asym)=0.9 *3*.
974.8 *2*	2.8 *3*	8704.4	65/2$^-$	7729.6	61/2$^-$	Q	R(asym)=1.0 *3*.
1020.4 *2*	1.8 *6*	8865.1	65/2$^+$	7844.7	61/2$^+$	Q	R(asym)=0.8 *3*.
1022 *1*	2.0 *5*	3325.0	(37/2$^+$)	2303.0	33/2$^+$		
1024.4 *5*	1.4 *7*	9367.7	67/2$^-$	8343.3	63/2$^-$	Q	R(asym)=1.0 *3*.
1029.9 *2*	2.2 *4*	9734.4	69/2$^-$	8704.4	65/2$^-$	Q	R(asym)=1.0 *3*.
1053[g] *1*	<1	11847.5?	(77/2$^-$)	10794.5	73/2$^-$		
1058.1 *5*	1.3 *6*	9923.2	(69/2$^+$)	8865.1	65/2$^+$		
1060.1 *5*	0.7 *3*	10794.5	73/2$^-$	9734.4	69/2$^-$	Q	R(asym)=1.2 *4*.

[†] From 1987Be07 (for Eγ>197), from the Adopted Gammas (Eγ<197). Uncertainties assigned as 0.2 to 0.5 keV, based on a general statement by 1987Be07. For Eγ quoted to nearest keV, Δ(Eγ)=1 keV assigned by the evaluators.

[‡] From 1987Be07. Uncertainties of 10-50% assigned based on a general statement by 1987Be07.

[#] Probably contaminated by another transition.

[@] Line masked by a transition of the same energy in ^{164}Yb or ^{166}Yb.

[&] From 1982Ro08.

[a] From 1979Ri06 only, uncertainty estimated by the evaluators.

[b] The mult=Q (for ΔJ=2, quadrupole) or D (for ΔJ=1, dipole or dipole with some quadrupole admixture) assigned by the evaluators based on the $\gamma\gamma(\theta)$ data in 1987Be07. The E2 or E2+M1 assignments are based on K/L ratios measured by 1979Ri06, and from RUL when level half−life is measured by 1979Ri06.

[c] Measured A_2 and A_4 values from $\gamma(\theta)$ are consistent with stretched quadrupole, as stated in 1974Ri12, while those values are not listed by the authors.

[d] Predominantly dipole indicated by measured $\gamma(\theta)$ as stated in 1974Ri12.

[e] 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.

[f] Multiply placed with undivided intensity.

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

$^{165}_{70}Yb_{95}$-5

^{130}Te(^{40}Ar,5nγ) 1987Be07,1979Ri06,1974Ri12

Level Scheme

Intensities: Relative I_γ

& Multiply placed: undivided intensity given

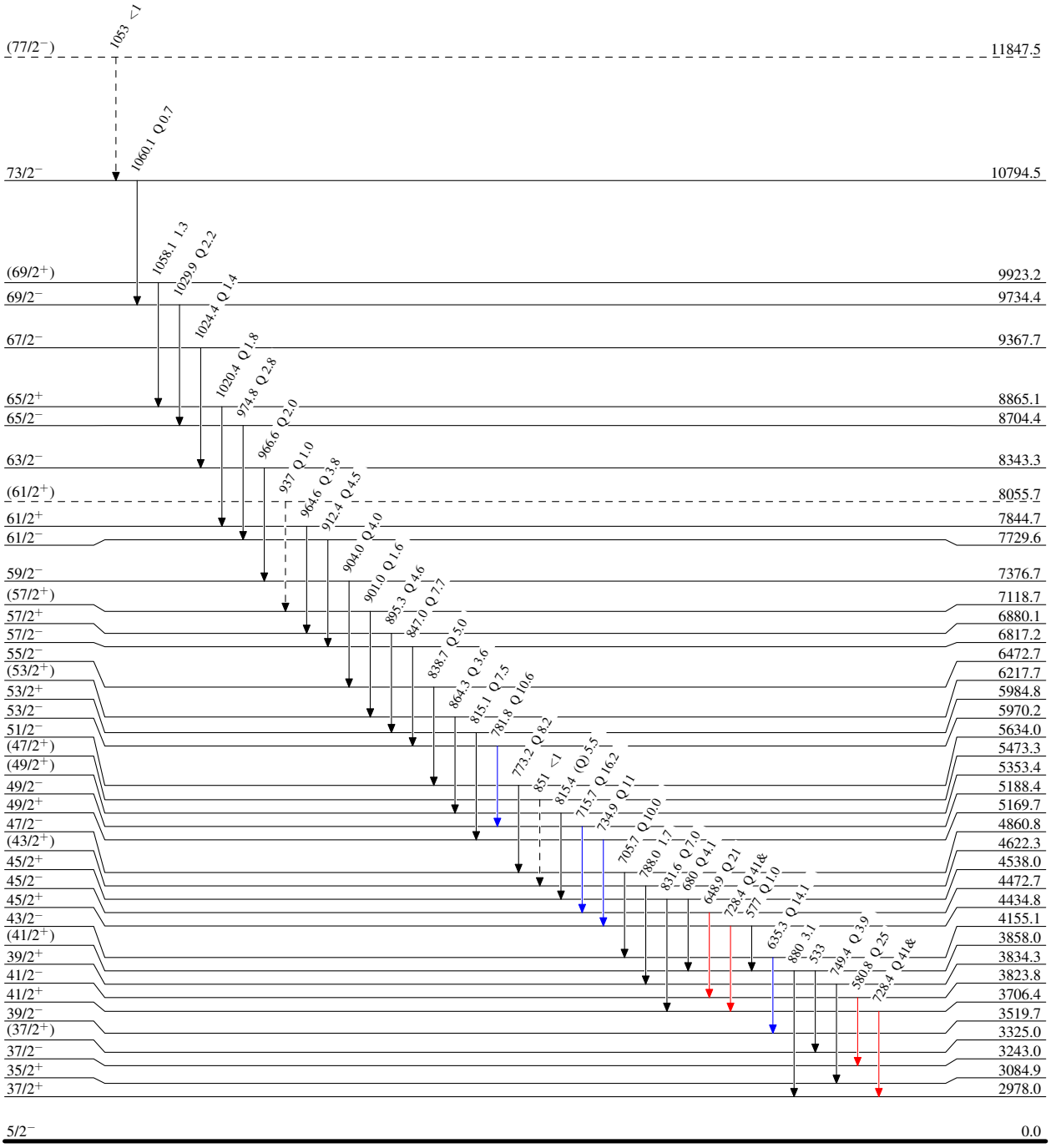
Legend

$I_\gamma < 2\% \times I_\gamma^{max}$

$I_\gamma < 10\% \times I_\gamma^{max}$

$I_\gamma > 10\% \times I_\gamma^{max}$

γ Decay (Uncertain)



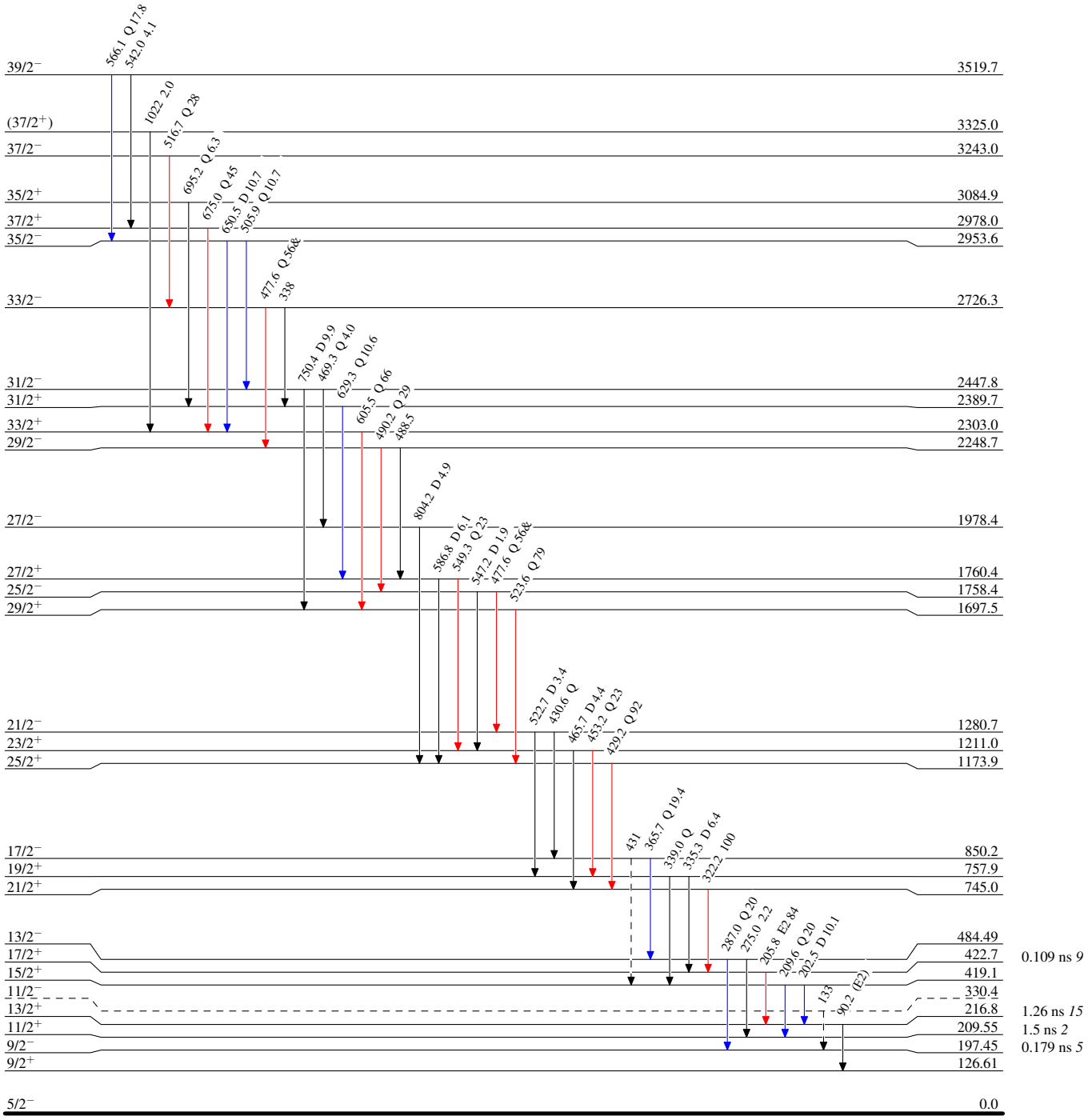
$^{165}_{70}Yb_{95}$

^{130}Te(^{40}Ar,5nγ) 1987Be07,1979Ri06,1974Ri12

Level Scheme (continued)

Intensities: Relative I_γ
& 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)

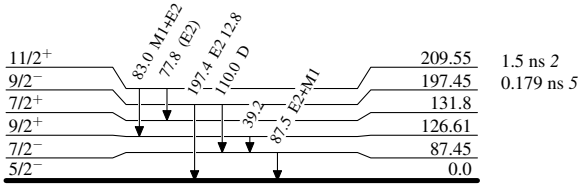


$^{165}_{70}Yb_{95}$

^{130}Te(^{40}Ar,5nγ) 1987Be07,1979Ri06,1974Ri12

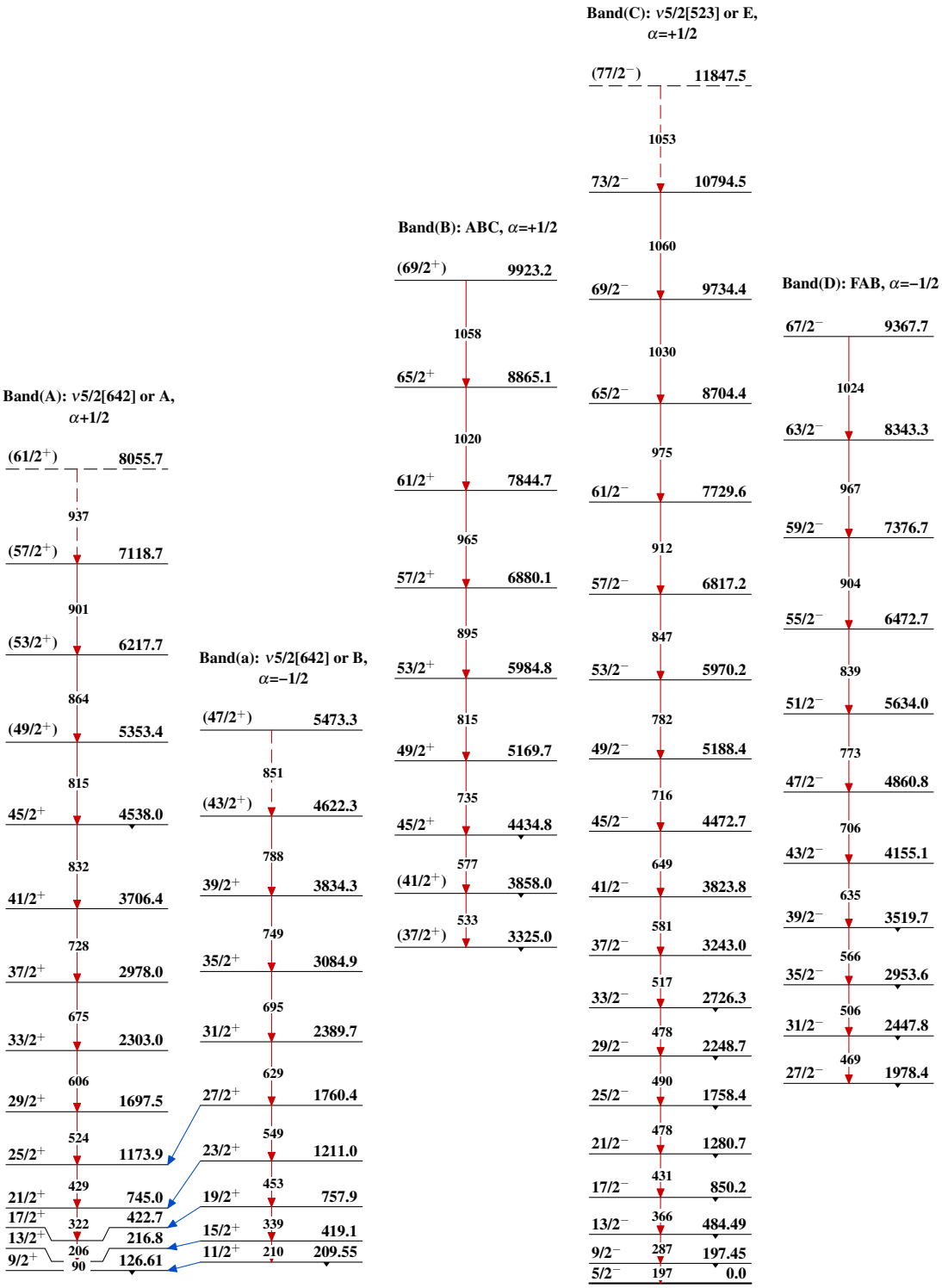
Level Scheme (continued)

Intensities: Relative I_γ
& Multiply placed: undivided intensity given



$^{165}_{70}Yb_{95}$

^{130}Te(^{40}Ar,5nγ) 1987Be07,1979Ri06,1974Ri12



$^{165}_{70}Yb_{95}$