(HI,xnγ):SD 1996Bo02,1998Bo32,1999Kr19

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	M. Shamsuzzoha Basunia	NDS 143, 1 (2017)	31-Mar-2017

1990Fe07: ^{160}Gd(^{37}Cl,4nγ) E=167 MeV; measured γ, γγ and deduced SD-1 and SD-2 bands.
1990KeZW; ^{176}Yb(^{23}Na,6nγ); E=116, 122 MeV; HERA Compton-suppressed Ge detector array (20 detectors); identified a 12-transition SD band which was tentatively assigned to ^{193}Tl. Authors give no other details.
1996Bo02, 1996Bo15: ^{181}Ta(^{18}O,6nγ) E=110 MeV. Measured Eγ, γγγ with EUROGAM2 array (126 Compton-suppressed Ge detectors (24 quad-clover and 30 Ge detectors)). Deduced SD-1 and SD-2 bands and interband transitions linking the two signature partners.
1998Bo32, 1998Bo20 (also 1996WiZY): ^{181}Ta(^{18}O,6nγ) E=110 MeV. Measured Eγ, 2- and 3-fold gated γγ coincidences with EUROGAM2 array (54 Compton-suppressed Ge detectors (24 quad-clover and 30 Ge detectors)). Deduced SD-3, SD-4 and SD-5 bands. Deduced transitions connecting SD-1 and SD-2 bands to normal bands.
1999Kr19: ^{176}Yb(^{23}Na,6nγ) E=129 MeV. GAMMASPHERE array of 100 Compton-suppressed HPGe detectors. Measured lifetimes by DSAM and deduced intrinsic quadrupole moments for SD-1 and SD-2 bands.

^{193}Tl Levels

E(level)	J$^{\pi}$	Comments
v†	(17/2^{+})	J$^{\pi}$: from 1998Bo20. Also from least-squares fits to Eγ's using empirical expansions relating second moment of inertia and angular frequency.
98+v‡	(19/2^{+})	J$^{\pi}$: calculated J=19/2 (1992Wu01,1993Hu06,1994Zh40).
206+v†	(21/2^{+})	J$^{\pi}$: calculated J=21/2 (1992Wu01,1993Hu06,1994Zh40).
325+v‡ *3*	(23/2^{+})	
454+v† *3*	(25/2^{+})	
593+v‡ *3*	(27/2^{+})	
741+v† *3*	(29/2^{+})	
901+v‡ *3*	(31/2^{+})	
1069+v† *3*	(33/2^{+})	
1249+v‡ *3*	(35/2^{+})	
1435+v† *3*	(37/2^{+})	
1636+v‡ *3*	(39/2^{+})	
1840+v† *3*	(41/2^{+})	
2062+v‡ *3*	(43/2^{+})	
2283+v† *3*	(45/2^{+})	
2525+v‡ *3*	(47/2^{+})	
2763+v† *3*	(49/2^{+})	
3027+v‡ *3*	(51/2^{+})	
3279+v† *3*	(53/2^{+})	
3564+v‡ *3*	(55/2^{+})	
3830+v† *3*	(57/2^{+})	
4137+v‡ *3*	(59/2^{+})	
4417+v† *3*	(61/2^{+})	
4746+v‡ *3*	(63/2^{+})	
5037+v† *3*	(65/2^{+})	
5390+v‡ *3*	(67/2^{+})	
5691+v† *3*	(69/2^{+})	
6069+v‡ *3*	(71/2^{+})	
6377+v† *3*	(73/2^{+})	

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(HI,xnγ):SD 1996Bo02,1998Bo32,1999Kr19 (continued)

^{193}Tl Levels (continued)

E(level)	J$^{\pi}$	Comments
6782+v[‡] *3*	(75/2^{+})	
7096+v[†] *3*	(77/2^{+})	
7529+v[‡] *3*	(79/2^{+})	
7847+v[†] *3*	(81/2^{+})	
8311+v[‡] *3*	(83/2^{+})	
8630+v[†] *4*	(85/2^{+})	
y[#]	J	J$^{\pi}$: ≈(15/2).
187.9+y[#] *3*	J+2	
418.6+y[#] *5*	J+4	
691.4+y[#] *6*	J+6	
1005.7+y[#] *6*	J+8	
1360.7+y[#] *7*	J+10	
1755.8+y[#] *8*	J+12	
2190.3+y[#] *8*	J+14	
2663.4+y[#] *9*	J+16	
3174.0+y[#] *9*	J+18	
3721.5+y[#] *10*	J+20	
4304.9+y[#] *10*	J+22	
4923.3+y[#] *11*	J+24	
5576.4+y[#] *11*	J+26	
6263.1+y[#] *12*	J+28	
6977.1+y[#] *14*	J+30	
7712.1+y[#] *17*	J+32	
z[@]	J1	J$^{\pi}$: ≈(23/2).
250.8+z[@] *3*	J1+2	
542.8+z[@] *5*	J1+4	
875.5+z[@] *6*	J1+6	
1248.2+z[@] *6*	J1+8	
1660.1+z[@] *7*	J1+10	
2110.6+z[@] *8*	J1+12	
2598.7+z[@] *8*	J1+14	
3123.9+z[@] *9*	J1+16	
3685.6+z[@] *9*	J1+18	
4282.5+z[@] *10*	J1+20	
4914.3+z[@] *10*	J1+22	
5580.7+z[@] *11*	J1+24	
6285.4+z[@] *13*	J1+26	
7033.4+z[@] *16*	J1+28	
u[&]	J2	J$^{\pi}$: ≈(21/2).
271.5+u[&] *5*	J2+2	
584.8+u[&] *7*	J2+4	
938.9+u[&] *7*	J2+6	
1332.2+u[&] *9*	J2+8	
1764.5+u[&] *9*	J2+10	
2234.4+u[&] *10*	J2+12	

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(HI,xnγ):SD 1996Bo02,1998Bo32,1999Kr19 (continued)

^{193}Tl Levels (continued)

E(level)	J^π	E(level)	J^π	E(level)	J^π
2741.7+u[&] *10*	J2+14	3864.8+u[&] *11*	J2+18	5128.8+u[&] *13*	J2+22
3285.4+u[&] *10*	J2+16	4479.3+u[&] *12*	J2+20	5813.0+u[&] *13*	J2+24
				6531.8+u[&] *15*	J2+26

[†] Band(A): SD-1 band α=+1/2. (1990Fe07,1996Bo02,1998Bo20,1999Kr19). Percent population is ≈0.5 of total yield for ^{193}Tl (1990Fe07). Q(intrinsic)=18.3 *10* (1999Kr19). From competing M1 (interband) and E2 (intraband) transitions, g_K=1.46 *17* (1996Bo02) and g_s^{eff}/g_s^{free}=0.7 *2* (1996Bo02).

[‡] Band(a): SD-2 band α=−1/2. (1990Fe07,1996Bo02,1998Bo20,1999Kr19). percent population is ≈0.5 of total yield for ^{193}Tl (1990Fe07). Q(intrinsic)=17.4 *10* (1999Kr19). The two SD bands (SD Band 1 and SD Band 2) are interpreted as signature partners influenced by the i13/2 proton intruder orbital. From competing M1 (interband) and E2 (intraband) transitions, g_K=1.46 *17* (1996Bo02) and g_s^{eff}/g_s^{free}=0.7 *2* (1996Bo02).

[#] Band(B): SD-3 band. Population intensity=60% of SD-2 band. Interaction observed between SD-3 and SD-4 bands, and the identical energies (within 2 keV) of transitions in SD-3 and SD-5 bands, indicate involvement of 1/2[411], α=±1/2 and 1/2[651], α=−1/2 proton orbitals. At high frequencies SD-3 is interpreted to be due to 1/2[651], α=−1/2, while at low frequencies, it is expected to be due to 1/2[411] α=−1/2 (1998Bo32).

[@] Band(C): SD-4 band. Population intensity=33% of SD-2 band. At high frequencies SD-4 Interaction is observed between SD-3 and SD-4 bands. is interpreted to be due to 1/2[411], α=−1/2, while at low frequencies it is interpreted as 1/2[651], α=−1/2 (1998Bo32).

[&] Band(D): SD-5 band. Population intensity=16% of SD-2 band. Identical energies (within 2 keV) of transitions in SD-3 and SD-5 bands indicate that these bands may be signature partners. SD-5 band is interpreted as 1/2[411], α=+1/2 (1998Bo32).

γ(^{193}Tl)

E_γ[†]	I_γ[#]	E_i(level)	J_i^π	E_f	J_f^π	Mult.	Comments
108.0 *3*		206+v	(21/2$^+$)	98+v	(19/2$^+$)		
118.9 *3*		325+v	(23/2$^+$)	206+v	(21/2$^+$)		
128.3 *3*		454+v	(25/2$^+$)	325+v	(23/2$^+$)		
139.2 *3*		593+v	(27/2$^+$)	454+v	(25/2$^+$)	(M1)	Mult.: α(exp)(139γ+148γ)=2.6 *8* (1996Bo02); theory: α(K)(M1)=2.73.
148.2 *3*		741+v	(29/2$^+$)	593+v	(27/2$^+$)	(M1)	Mult.: α(exp)(139γ+148γ)=2.6 *8* and α(exp)(148γ+160γ)=3.0 *8* (1996Bo02); theory: α(K)(M1)=2.29.
160.1 *3*		901+v	(31/2$^+$)	741+v	(29/2$^+$)	(M1)	Mult.: α(exp)(148γ+160γ)=3.0 *8* (1996Bo02); theory: α(K)(M1)=1.84.
167.4 *3*		1069+v	(33/2$^+$)	901+v	(31/2$^+$)	(M1)	Mult.: α(exp)(167γ+181γ)=2.2 *5* (1996Bo02): theory: α(K)(M1)=1.622.
180.6 *3*		1249+v	(35/2$^+$)	1069+v	(33/2$^+$)	(M1)	Mult.: α(exp)(167γ+181γ)=2.2 *5* and α(exp)(181γ+186γ)=1.8 *7* (1996Bo02); theory: α(K)(M1)=1.31.
185.8 *3*		1435+v	(37/2$^+$)	1249+v	(35/2$^+$)	(M1)	Mult.: α(exp)(181γ+186γ)=1.8 *7* and α(exp)(186γ+201γ)=1.4 *6* (1996Bo02); theory: α(K)(M1)=1.21.
187.9 *3*		187.9+y	J+2	y	J		
201.4 *3*		1636+v	(39/2$^+$)	1435+v	(37/2$^+$)	(M1)	Mult.: α(exp)(186γ+201γ)=1.4 *6* (1996Bo02); theory: α(K)(M1)=0.965.
203.5 *3*		1840+v	(41/2$^+$)	1636+v	(39/2$^+$)		
206.6 *3*		206+v	(21/2$^+$)	v	(17/2$^+$)		
221.5 *3*		2062+v	(43/2$^+$)	1840+v	(41/2$^+$)		
227.3 *3*	0.98 *10*	325+v	(23/2$^+$)	98+v	(19/2$^+$)		

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(HI,xnγ):SD 1996Bo02,1998Bo32,1999Kr19 (continued)

$\gamma(^{193}Tl)$ (continued)

E_γ[†]	I_γ[#]	E_i(level)	J^π_i	E_f	J^π_f
230.7 *3*		418.6+y	J+4	187.9+y	J+2
247.3 *3*	0.39 *6*	454+v	(25/2+)	206+v	(21/2+)
250.8 *3*		250.8+z	J1+2	z	J1
267.9 *3*	1.13[@] *23*	593+v	(27/2+)	325+v	(23/2+)
271.5 *5*		271.5+u	J2+2	u	J2
272.8 *3*		691.4+y	J+6	418.6+y	J+4
287.7 *3*	0.45 *5*	741+v	(29/2+)	454+v	(25/2+)
292.0 *3*		542.8+z	J1+4	250.8+z	J1+2
308.2 *3*	0.86 *9*	901+v	(31/2+)	593+v	(27/2+)
313.4 *4*		584.8+u	J2+4	271.5+u	J2+2
314.3 *3*		1005.7+y	J+8	691.4+y	J+6
327.4 *3*	0.53 *5*	1069+v	(33/2+)	741+v	(29/2+)
332.7 *3*		875.5+z	J1+6	542.8+z	J1+4
348.0 *3*	1.01 *11*	1249+v	(35/2+)	901+v	(31/2+)
354.1 *3*		938.9+u	J2+6	584.8+u	J2+4
355.0 *3*		1360.7+y	J+10	1005.7+y	J+8
366.4 *3*	1.15 *23*	1435+v	(37/2+)	1069+v	(33/2+)
372.7 *3*		1248.2+z	J1+8	875.5+z	J1+6
387.0 *3*	1.4 *4*	1636+v	(39/2+)	1249+v	(35/2+)
393.3 *4*		1332.2+u	J2+8	938.9+u	J2+6
395.1 *3*		1755.8+y	J+12	1360.7+y	J+10
405.3 *4*	0.93 *19*	1840+v	(41/2+)	1435+v	(37/2+)
411.9 *3*		1660.1+z	J1+10	1248.2+z	J1+8
425.4 *3*	1.22 *12*	2062+v	(43/2+)	1636+v	(39/2+)
432.3 *3*		1764.5+u	J2+10	1332.2+u	J2+8
434.5 *3*		2190.3+y	J+14	1755.8+y	J+12
442.9 *3*		2283+v	(45/2+)	1840+v	(41/2+)
450.5 *3*		2110.6+z	J1+12	1660.1+z	J1+10
463.7 *3*	1.60[@] *16*	2525+v	(47/2+)	2062+v	(43/2+)
469.9 *3*		2234.4+u	J2+12	1764.5+u	J2+10
473.1 *3*		2663.4+y	J+16	2190.3+y	J+14
479.7 *3*	0.72 *17*	2763+v	(49/2+)	2283+v	(45/2+)
488.1 *3*		2598.7+z	J1+14	2110.6+z	J1+12
501.1 *3*		3027+v	(51/2+)	2525+v	(47/2+)
507.3 *3*		2741.7+u	J2+14	2234.4+u	J2+12
510.6 *3*		3174.0+y	J+18	2663.4+y	J+16
516.1 *3*	1.11 *17*	3279+v	(53/2+)	2763+v	(49/2+)
525.2 *3*		3123.9+z	J1+16	2598.7+z	J1+14
537.5 *3*	1.30 *14*	3564+v	(55/2+)	3027+v	(51/2+)
543.7 *3*		3285.4+u	J2+16	2741.7+u	J2+14
547.5 *3*		3721.5+y	J+20	3174.0+y	J+18
551.6 *3*	1.00 *14*	3830+v	(57/2+)	3279+v	(53/2+)
561.7 *3*		3685.6+z	J1+18	3123.9+z	J1+16
573.4 *3*	1.00 *10*	4137+v	(59/2+)	3564+v	(55/2+)
579.4 *4*		3864.8+u	J2+18	3285.4+u	J2+16
583.4 *3*		4304.9+y	J+22	3721.5+y	J+20
586.5 *3*	0.84 *17*	4417+v	(61/2+)	3830+v	(57/2+)
596.9 *3*		4282.5+z	J1+20	3685.6+z	J1+18
608.8 *3*	0.96 *10*	4746+v	(63/2+)	4137+v	(59/2+)
614.5 *4*		4479.3+u	J2+20	3864.8+u	J2+18
618.4 *3*		4923.3+y	J+24	4304.9+y	J+22
620.3 *3*	0.81 *13*	5037+v	(65/2+)	4417+v	(61/2+)
631.8 *3*		4914.3+z	J1+22	4282.5+z	J1+20
643.8 *3*	1.09 *22*	5390+v	(67/2+)	4746+v	(63/2+)
649.5 *4*		5128.8+u	J2+22	4479.3+u	J2+20
653.1 *3*		5576.4+y	J+26	4923.3+y	J+24

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(HI,xnγ):SD 1996Bo02,1998Bo32,1999Kr19 (continued)

γ(^{193}Tl) (continued)

Eγ†	Iγ#	Ei(level)	J^π_i	Ef	J^π_f	Comments
653.6 *4*	0.42 *11*	5691+v	(69/2+)	5037+v	(65/2+)	
666.4 *3*		5580.7+z	J1+24	4914.3+z	J1+22	
678.7 *4*	0.75 *14*	6069+v	(71/2+)	5390+v	(67/2+)	
684.2 *4*		5813.0+u	J2+24	5128.8+u	J2+22	
686.1 *4*	0.46 *11*	6377+v	(73/2+)	5691+v	(69/2+)	
686.7 *4*		6263.1+y	J+28	5576.4+y	J+26	
704.7 *7*		6285.4+z	J1+26	5580.7+z	J1+24	
713.2 *5*		6782+v	(75/2+)	6069+v	(71/2+)	
714.0 *7*		6977.1+y	J+30	6263.1+y	J+28	
718.7 *5*		7096+v	(77/2+)	6377+v	(73/2+)	
718.8 *7*		6531.8+u	J2+26	5813.0+u	J2+24	
735.0 *10*		7712.1+y	J+32	6977.1+y	J+30	
747.5 *5*		7529+v	(79/2+)	6782+v	(75/2+)	
748.0 *10*		7033.4+z	J1+28	6285.4+z	J1+26	
751.3 *5*		7847+v	(81/2+)	7096+v	(77/2+)	
781.9 *5*		8311+v	(83/2+)	7529+v	(79/2+)	
783.4 *5*		8630+v	(85/2+)	7847+v	(81/2+)	
x3046‡ *6*						Eγ: Depopulating (21/2+) state at 206+V (1998Bo20).
x3113‡ *5*						Eγ: Depopulating (19/2+) state at 98+V (1998Bo20).
x3134‡ *4*						Eγ: Depopulating (17/2+) state at V (1998Bo20).

† From 1996Bo02 for γ's in SD-1 and SD-2 bands; from 1998Bo32 for γ's in SD-3, SD-4 and SD-5 bands. Interconnecting transitions from SD-1 and SD-2 bands to normal bands are from 1998Bo20. Eγ's for levels up to 2575 are from adopted gammas.

‡ Identified by 1998Bo20 as out of the two signature partners of SD bands (SD Band 1 and 2) and proposed connection with members of normal deformed states of 1992Re08. The proposed connections do not fit with current data of 2016NdZZ, since the location of 1765.9 (2131+X) level (J^π=15/2+) changed to 1865.7 (2230.9+X) (J^π=21/2+). The evaluator placed the transition as unplaced with notes of the depopulating state.

\# From 1990Fe07 (^{160}Gd(^{37}Cl,4nγ) E=167 MeV). Values are relative transition intensities within the band deduced from γγ data with gate on 500.7γ for SD-1 and gate on 443.0γ for SD-2. Intensity plots are given by 1998Bo32 for SD-3, SD-4 and SD-5 bands.

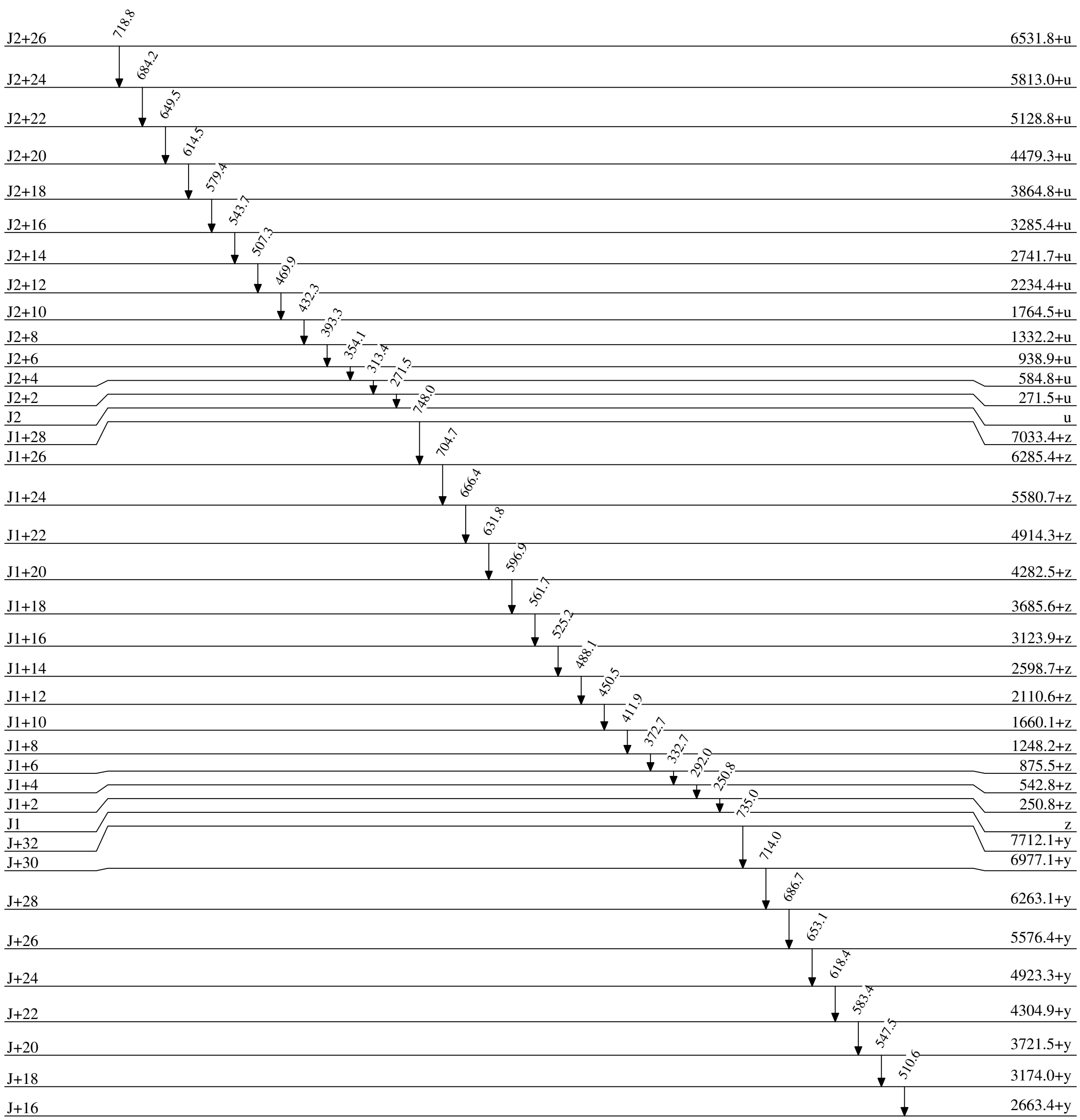
@ Contains contribution from another unresolved transition in ^{193}Tl.

x γ ray not placed in level scheme.

(HI,xnγ):SD 1996Bo02,1998Bo32,1999Kr19

Level Scheme

Intensities: Relative Iγ within each band



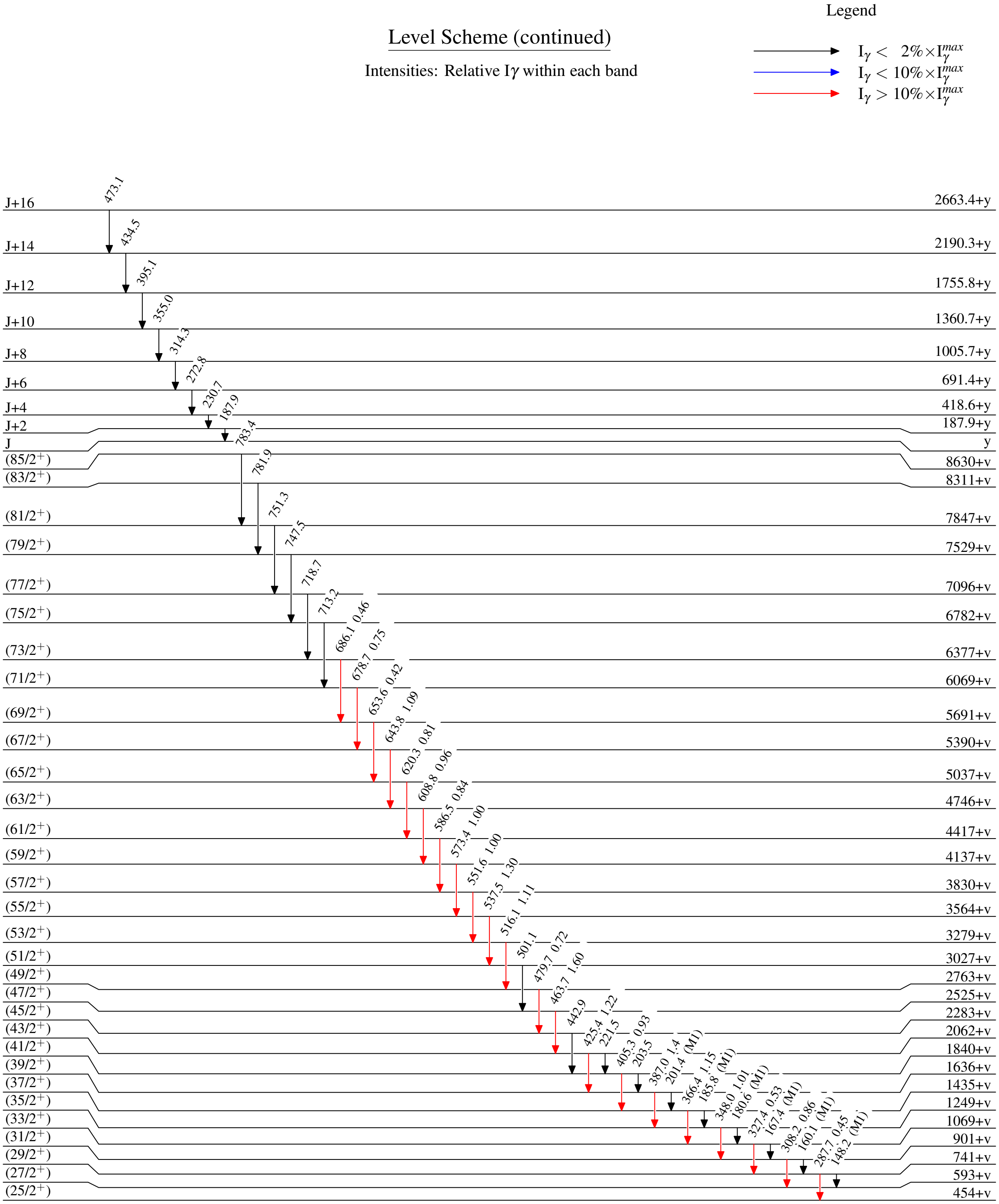
$^{193}_{81}Tl_{112}$

(HI,xnγ):SD 1996Bo02,1998Bo32,1999Kr19

Level Scheme (continued)

Intensities: Relative Iγ within each band

Legend



$^{193}_{81}Tl_{112}$

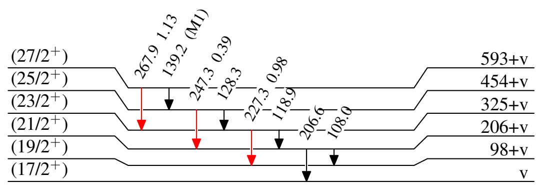
(HI,xnγ):SD 1996Bo02,1998Bo32,1999Kr19

Legend

Level Scheme (continued)

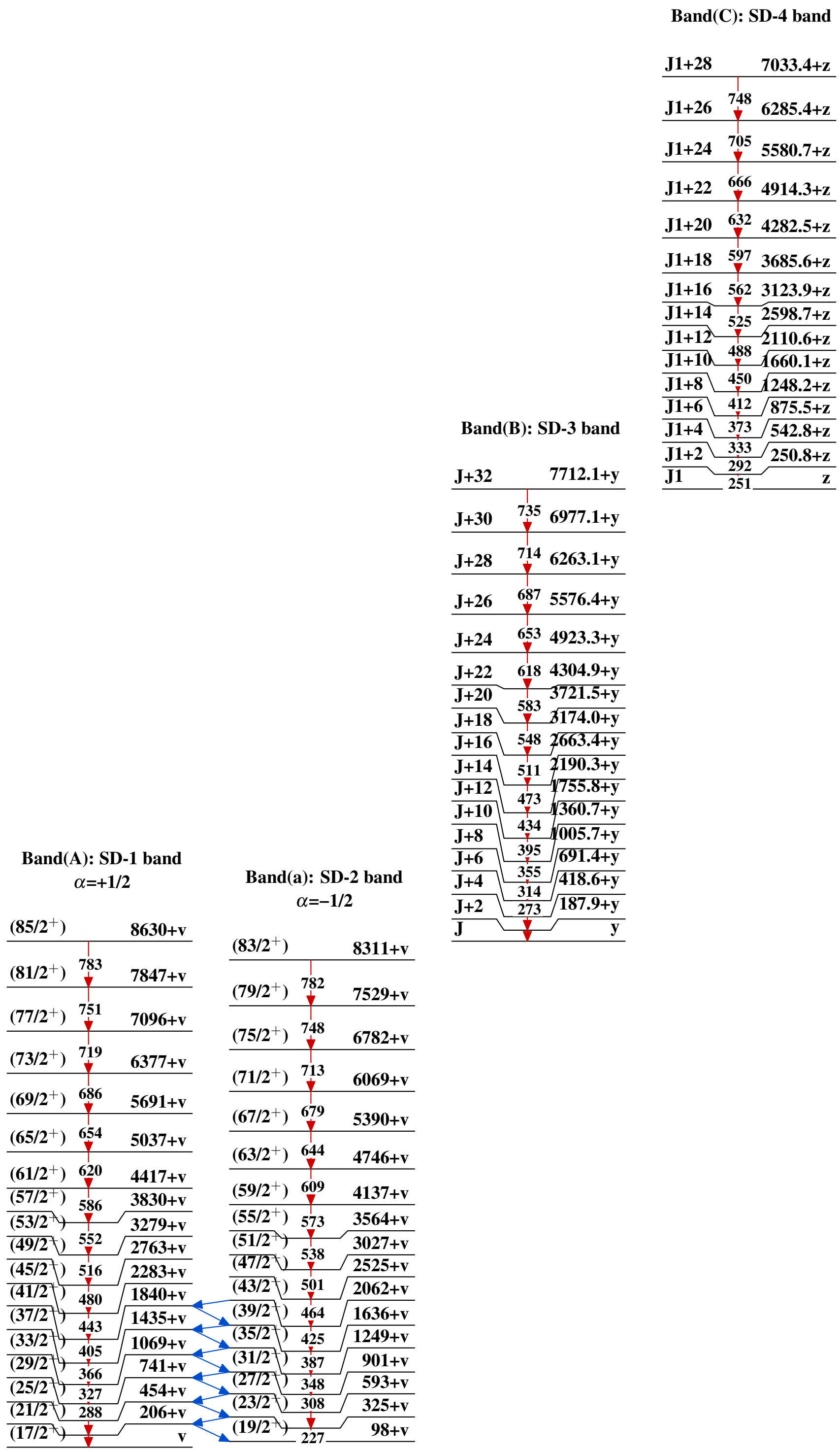
Intensities: Relative Iγ within each band

- $I_\gamma < 2\% \times I_\gamma^{max}$
- $I_\gamma < 10\% \times I_\gamma^{max}$
- $I_\gamma > 10\% \times I_\gamma^{max}$



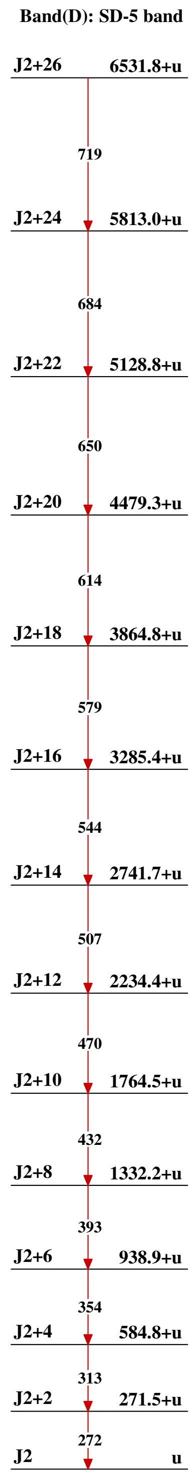
$^{193}_{81}\mathrm{Tl}_{112}$

(HI,xnγ):SD 1996Bo02,1998Bo32,1999Kr19



$^{193}_{81}Tl_{112}$

(HI,xnγ):SD 1996Bo02,1998Bo32,1999Kr19 (continued)



$^{193}_{81}Tl_{112}$