^{96}Ru(^{40}Ca,3pγ) 1996Ga17

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Yu. Khazov and A. Rodionov, F. G. Kondev	NDS 112, 855 (2011)	31-Oct-2010

1996Ga17: ^{96}Ru(^{40}Ca,3pγ), E=176 MeV; measured Eγ, Iγ, $\gamma\gamma$, $\gamma\gamma(\theta)$ (DSAM); deduced levels, J^{π}, δ, band structure. Tandem, an 8π array of 20 HPGe anti-Compton shielded detectors, spherical shell of 71 BGO, models comparison.

1991Re03 (also 1991ReZY): ^{96}Ru(^{40}Ca,3pn), E=180 MeV; measured $\gamma\gamma$, nγ, nnγ, (recoil)γ-, n(recoil)γ-coin.; deduced transitions between six rotational bands. POLYTESSA array, 10 Compton suppressed detectors.

2001Ri20 (also 2002La09): ^{105}Pd(^{35}Cl,α3nγ), E=173 MeV; measured γ, $\gamma\gamma(\theta)$ (DSAM); ^{133}Pm deduced Q(intrinsic) of the bands. Cyclotron, GAMMASPHERE spectrometer, MICROBALL detector of charged particles.

Other: 1987Wa02 ($T_{1/2}$ measurements by RDM).

^{133}Pm Levels

E(level)[†]	J^{π}[‡]	$T_{1/2}$	Comments
0.0[#]	$3/2^+$		This state may not necessarily be the g.s., since the experiment is not sensitive to isomeric decay.
84.48[@] *23*	$5/2^+$		
129.7[&] *7*	$11/2^-$		
147.9[a] *8*	$9/2^-$		
214.2[#] *3*	$7/2^+$		
371.9 *3*	$(7/2^+)$		
381.9[@] *3*	$9/2^+$		
382.1[&] *7*	$15/2^-$	50 ps *4*	$T_{1/2}$: from 1987Wa02.
410.4[a] *7*	$13/2^-$		
571.6[#] *3*	$11/2^+$		
653.4[c] *3*	$9/2^+$		
802.5[@] *3*	$13/2^+$		
810.1[b] *4*	$11/2^+$		
812.0[&] *7*	$19/2^-$		
815.9[d] *7*	$15/2^-$		
820.3[a] *7*	$17/2^-$		
991.2[c] *4*	$13/2^+$		
1025.3[#] *3*	$15/2^+$		
1196.6[b] *4*	$15/2^+$		
1226.9[d] *7*	$(19/2)^-$		
1294.9[@] *4*	$17/2^+$		
1334.2[a] *7*	$21/2^-$		
1383.4[&] *7*	$23/2^-$		
1425.4[c] *4*	$17/2^+$		
1534.8[#] *4*	$19/2^+$		
1677.4[b] *4*	$19/2^+$		
1758.4[d] *7*	$(23/2)^-$		
1830.6[@] *4*	$21/2^+$		
1927.9[a] *7*	$25/2^-$		
1952.1[c] *5*	$21/2^+$		
2058.9[&] *7*	$27/2^-$		
2081.4[#] *4*	$23/2^+$		
2249.1[b] *5*	$23/2^+$		
2388.9[d] *7*	$(27/2)^-$		

Continued on next page (footnotes at end of table)

^{96}Ru(^{40}Ca,3pγ) 1996Ga17 (continued)

^{133}Pm Levels (continued)

E(level)[†]	J^{π}[‡]	E(level)[†]	J^{π}[‡]	E(level)[†]	J^{π}[‡]	E(level)[†]	J^{π}[‡]
2397.1[@] *4*	25/2+	3609.1[&] *8*	35/2−	4926.2[c] *7*	37/2+	6796.8[#] *10*	47/2+
2567.6[c] *5*	25/2+	3655.3[b] *6*	31/2+	4927.6[#] *7*	39/2+	7137.3[a] *19*	49/2−
2598.5[a] *7*	29/2−	3671.8[@] *5*	33/2+	5096.8[a] *10*	41/2−	7278.6[@] *14*	49/2+
2674.4[#] *4*	27/2+	3911.0[d] *13*	(35/2)−	5337.4[@] *9*	41/2+	7492.1[&] *13*	51/2−
2805.4[&] *7*	31/2−	4059.5[c] *6*	33/2+	5390.0[b] *12*	39/2+	7768.8[#] *12*	51/2+
2909.3[b] *5*	27/2+	4089.2[#] *5*	35/2+	5409.1[&] *8*	43/2−	8290.5[@] *17*	53/2+
2991.6[@] *5*	29/2+	4180.8[a] *8*	37/2−	5838.3[#] *9*	43/2+	8646.6[&] *19*	55/2−
3114.9[d] *7*	(31/2)−	4457.7[@] *7*	37/2+	5872.3[c] *12*	41/2+	8767.3[#] *14*	55/2+
3271.9[c] *5*	29/2+	4474.8[&] *8*	39/2−	6099.8[a] *14*	45/2−	9361.5[@] *23*	57/2+
3338.1[#] *5*	31/2+	4480.0[b] *6*	35/2+	6290.7[@] *11*	45/2+	9877.7[&] *25*	59/2−
3348.5[a] *8*	33/2−	4773.0[d] *16*	(39/2)−	6414.0[&] *11*	47/2−		

[†] From a least-squares fit to Eγ.

[‡] From 1996Ga17, based on DCO value analysis and systematics.

[#] Band(A): 1-qp band based on the (3/2$^+$) g.s., α=−1/2. configuration=π3/2[411] (d$_{5/2}$). Q(intrinsic)=5.4 eb *6* (1996Ga17) and 4.1 eb *2* (2001Ri20).

[@] Band(B): 1-qp band based on the (5/2$^+$) state at 84.5-keV, α=+1/2. configuration=π3/2[411] (d$_{5/2}$). Q(intrinsic)=5.4 eb *6* (1996Ga17) and 4.1 eb *2* (2001Ri20).

[&] Band(C): 1-qp band based on the (11/2$^-$) state 129.7-keV, α=−1/2. configuration=π3/2[541] (h$_{11/2}$), strongly Coriolis mixed. Q(intrinsic)=5.2 eb *5* (1996Ga17) and 4.0 eb *2* (2001Ri20).

[a] Band(D): 1-qp band based on the (9/2$^-$)state 147.9-keV, α=+1/2. configuration=π3/2[541] (h$_{11/2}$), strongly Coriolis mixed. Q(intrinsic)=5.2 eb *5* (1996Ga17) and 4.0 eb *2* (2001Ri20).

[b] Band(E): 1-qp band based on the (11/2$^+$) state at 810.1-keV, α=−1/2. configuration=π9/2[404] (g$_{9/2}$). Q(intrinsic)=7.4 eb *10* (1996Ga17) and 5.0 eb 4 (2001Ri20,2002La09).

[c] Band(F): 1-qp band based on the (9/2$^+$) state at 653.4-keV, α=+1/2. configuration=π9/2[404] (g$_{9/2}$). Q(intrinsic)=7.4 eb *10* (1996Ga17) and 5.0 eb 4 (2001Ri20,2002La09).

[d] Band(G): 1-qp band based on the (15/2$^-$) state at 815.9-keV, α=+1/2. Probable configuration=h$_{11/2}$, strongly Coriolis mixed band.

γ(^{133}Pm)

E$_\gamma$[†]	I$_\gamma$[‡]	E$_i$(level)	J^{π}_i	E$_f$	J^{π}_f	Mult.[#]	δ[@]	Comments
84.44 *27*	≈2	84.48	5/2+	0.0	3/2+			
129.52 *19*	14.6 *15*	214.2	7/2+	84.48	5/2+	M1+E2	0.150 *16*	R(DCO)= 1.45 *5*, 1.00 *4*.
156.35 *21*	5.4 *3*	810.1	11/2+	653.4	9/2+	M1+E2	0.23 *3*	R(DCO)= 1.21 *12*.
167.0 *3*	13.0 *6*	381.9	9/2+	214.2	7/2+	M1+E2	0.178 *16*	R(DCO)= 1.49 *7*, 1.07 *4*.
180.45 *25*	6.0 *3*	991.2	13/2+	810.1	11/2+	M1+E2	0.25 *3*	R(DCO)= 1.28 *12*.
189.35 *23*	11.2 *6*	571.6	11/2+	381.9	9/2+	M1+E2	0.195 *24*	R(DCO)= 1.43 *11*, 1.09 *6*.
205.0 *3*	6.8 *3*	1196.6	15/2+	991.2	13/2+	M1+E2	0.23 *3*	R(DCO)= 1.21 *12*.
214.0 *5*	5.8 *6*	214.2	7/2+	0.0	3/2+			
222.4 *4*	6.9 *3*	1025.3	15/2+	802.5	13/2+	M1+E2	0.15 *3*	R(DCO)= 1.35 *9*, 1.00 *8*.
228.55 *25*	5.3 *3*	1425.4	17/2+	1196.6	15/2+	M1+E2	0.24 *3*	R(DCO)= 1.25 *12*.
230.80 *21*	8.9 *5*	802.5	13/2+	571.6	11/2+	M1+E2	0.18 *3*	R(DCO)= 1.46 *9*, 1.06 *8*.
239.5 *7*	4.9 *3*	1534.8	19/2+	1294.9	17/2+	M1+E2	0.12 *4*	R(DCO)= 1.38 *10*, 0.92 *10*.
250.8[&] *3*	3.6 *2*	2081.4	23/2+	1830.6	21/2+			
251.82 *27*	4.5 *3*	1677.4	19/2+	1425.4	17/2+			
252.45 *23*	140 *3*	382.1	15/2−	129.7	11/2−	E2		R(DCO)= 2.02 *4*.

Continued on next page (footnotes at end of table)

^{96}Ru(^{40}Ca,3pγ) 1996Ga17 (continued)

γ(^{133}Pm) (continued)

E_γ †	I_γ ‡	E_i(level)	J^π_i	E_f	J^π_f	Mult.#	δ@	Comments
262.55 *23*	25 *1*	410.4	13/2⁻	147.9	9/2⁻	E2		R(DCO)= 1.92 *15*.
269.45 *21*	6.8 *4*	1294.9	17/2⁺	1025.3	15/2⁺	M1+E2	0.12 *4*	R(DCO)= 1.38 *10*, 0.93 *10*.
271.6& *10*	0.9 *1*	653.4	9/2⁺	381.9	9/2⁺			
274.46 *24*	4.0 *3*	1952.1	21/2⁺	1677.4	19/2⁺	M1+E2	0.23 *5*	R(DCO)= 1.23 *15*.
277.4& *3*	2.3 *2*	2674.4	27/2⁺	2397.1	25/2⁺			
280.75 *23*	23 *1*	410.4	13/2⁻	129.7	11/2⁻			R(DCO)= 2.49 *8*.
281.6& *2*	3.3 *3*	653.4	9/2⁺	371.9	(7/2⁺)			R(DCO)= 1.3 *4*.
287.4& *2*	2.1 *1*	371.9	(7/2⁺)	84.48	5/2⁺			R(DCO)= 1.22 *15*.
295.60 *27*	5.6 *3*	1830.6	21/2⁺	1534.8	19/2⁺	M1+E2	0.13 *6*	R(DCO)= 1.35 *12*.
296.99 *24*	3.0 *4*	2249.1	23/2⁺	1952.1	21/2⁺			
297.72 *24*	17 *8*	381.9	9/2⁺	84.48	5/2⁺	E2		R(DCO)= 1.93 *13*.
309.5& *3*	2.2 *3*	3114.9	(31/2)⁻	2805.4	31/2⁻			
315.8& *3*	4.7 *4*	2397.1	25/2⁺	2081.4	23/2⁺			
317.3& *5*	2.4 *3*	2991.6	29/2⁺	2674.4	27/2⁺			
318.53 *26*	2.2 *5*	2567.6	25/2⁺	2249.1	23/2⁺			
329.9& *3*	2.1 *3*	2388.9	(27/2)⁻	2058.9	27/2⁻			
338.39 *29*	1.51 *15*	991.2	13/2⁺	653.4	9/2⁺			
341.66 *28*	1.9 *4*	2909.3	27/2⁺	2567.6	25/2⁺			
357.42 *19*	21.3 *9*	571.6	11/2⁺	214.2	7/2⁺	E2		R(DCO)= 1.99 *9*.
362.58 *19*	1.4 *3*	3271.9	29/2⁺	2909.3	27/2⁺			
372.6& *7*	1.2 *6*	371.9	(7/2⁺)	0.0	3/2⁺			
374.9& *3*	3.8 *3*	1758.4	(23/2)⁻	1383.4	23/2⁻			R(DCO)= 2.10 *15*.
383.0 *6*	1.6 *4*	3655.3	31/2⁺	3271.9	29/2⁺			
386.7 *3*	2.27 *20*	1196.6	15/2⁺	810.1	11/2⁺			
404& *1*	1.0 *4*	4059.5	33/2⁺	3655.3	31/2⁺			
405.1& *4*	3.0 *3*	815.9	15/2⁻	410.4	13/2⁻			
406.6& *3*	5.4 *4*	1226.9	(19/2)⁻	820.3	17/2⁻			R(DCO)= 1.9 *2*.
409.96 *17*	36 *2*	820.3	17/2⁻	410.4	13/2⁻			R(DCO)= 2.08 *17*.
411.0& *3*	5.6 *5*	1226.9	(19/2)⁻	815.9	15/2⁻			
415.0& *3*	5.9 *6*	1226.9	(19/2)⁻	812.0	19/2⁻			R(DCO)= 1.95 *25*.
420.73 *16*	27.2 *12*	802.5	13/2⁺	381.9	9/2⁺	E2		R(DCO)= 1.98 *15*.
424.1& *3*	4.3 *3*	1758.4	(23/2)⁻	1334.2	21/2⁻			R(DCO)= 1.8 *3*.
429.86 *17*	137 *6*	812.0	19/2⁻	382.1	15/2⁻	E2		R(DCO)= 1.99 *5*.
433.9& *3*	5.4 *7*	815.9	15/2⁻	382.1	15/2⁻			R(DCO)= 2.05 *15*.
434.4 *3*	3.45 *25*	1425.4	17/2⁺	991.2	13/2⁺			
438.09 *17*	13 *1*	820.3	17/2⁻	382.1	15/2⁻			R(DCO)= 2.36 *10*.
439.1& *2*	3.7 *3*	653.4	9/2⁺	214.2	7/2⁺			R(DCO)= 1.27 *25*.
453.73 *17*	29 *1*	1025.3	15/2⁺	571.6	11/2⁺	E2		R(DCO)= 1.98 *10*.
461.1& *2*	3.8 *4*	2388.9	(27/2)⁻	1927.9	25/2⁻			
480.96 *19*	3.84 *25*	1677.4	19/2⁺	1196.6	15/2⁺			
492.45 *21*	29.2 *15*	1294.9	17/2⁺	802.5	13/2⁺	E2		R(DCO)= 2.01 *10*.
509.49 *17*	36.7 *15*	1534.8	19/2⁺	1025.3	15/2⁺	E2		R(DCO)= 1.92 *15*.
514.4 *5*	41 *3*	1334.2	21/2⁻	820.3	17/2⁻	E2		R(DCO)= 1.93 *15*.
516.6& *3*	1.6 *3*	3114.9	(31/2)⁻	2598.5	29/2⁻			
522.20 *24*	9.5 *6*	1334.2	21/2⁻	812.0	19/2⁻			R(DCO)= 2.38 *15*.
526.74 *26*	4.35 *30*	1952.1	21/2⁺	1425.4	17/2⁺			
531.4& *3*	14.9 *7*	1758.4	(23/2)⁻	1226.9	(19/2)⁻			
535.80 *21*	29.4 *15*	1830.6	21/2⁺	1294.9	17/2⁺			
539.7& *3*	5 *1*	2598.5	29/2⁻	2058.9	27/2⁻			R(DCO)= 1.9 *2*. This value does not suggest the transition placement (1996Ga17) between levels with 29/2⁻ and 27/2⁻.

Continued on next page (footnotes at end of table)

^{96}Ru(^{40}Ca,3pγ) 1996Ga17 (continued)

γ(^{133}Pm) (continued)

E_γ[†]	I_γ[‡]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[#]	Comments
544.6[&] *3*	7.8 *6*	1927.9	25/2⁻	1383.4	23/2⁻		R(DCO)= 1.7 *2*. This value does not suggest the transition placement (1996Ga17) between levels with 25/2⁻ and 23/2⁻.
546.63 *17*	37.7 *15*	2081.4	23/2⁺	1534.8	19/2⁺		
566.4 *4*	26.7 *15*	2397.1	25/2⁺	1830.6	21/2⁺		
571.33 *16*	104 *5*	1383.4	23/2⁻	812.0	19/2⁻	E2	R(DCO)= 2.01 *10*.
571.9 *4*	4.0 *3*	2249.1	23/2⁺	1677.4	19/2⁺		
592.95 *21*	31.6 *20*	2674.4	27/2⁺	2081.4	23/2⁺		
593.80 *21*	34 *3*	1927.9	25/2⁻	1334.2	21/2⁻	E2	R(DCO)= 2.09 *20*.
594.46 *24*	22 *2*	2991.6	29/2⁺	2397.1	25/2⁺		
615.46 *19*	4.0 *3*	2567.6	25/2⁺	1952.1	21/2⁺		
630.3[&] *3*	19.2 *9*	2388.9	(27/2)⁻	1758.4	(23/2)⁻		
643[&] *1*	4.3 *4*	1025.3	15/2⁺	382.1	15/2⁻	E1[b]	R(DCO)= 1.9 *2*.
660.2 *5*	3.5 *4*	2909.3	27/2⁺	2249.1	23/2⁺		
663.68 *18*	22 *1*	3338.1	31/2⁺	2674.4	27/2⁺		
670.69 *24*	25 *3*	2598.5	29/2⁻	1927.9	25/2⁻		
675.47 *17*	66 *3*	2058.9	27/2⁻	1383.4	23/2⁻		
680.18 *18*	13.5 *7*	3671.8	33/2⁺	2991.6	29/2⁺		
698[&] *1*	3.7 *4*	2081.4	23/2⁺	1383.4	23/2⁻	E1[b]	R(DCO)= 1.8 *2*.
704.4 *4*	4.2 *4*	3271.9	29/2⁺	2567.6	25/2⁺		
723[&] *1*	5.3 *4*	1534.8	19/2⁺	812.0	19/2⁻	E1[b]	R(DCO)= 1.7 *2*.
725.9[&] *3*	16.2 *16*	3114.9	(31/2)⁻	2388.9	(27/2)⁻		
746.13 *20*	3.7 *6*	3655.3	31/2⁺	2909.3	27/2⁺		
746.50 *21*	39 *3*	2805.4	31/2⁻	2058.9	27/2⁻		
749.95 *23*	23 *2*	3348.5	33/2⁻	2598.5	29/2⁻		
751.07 *24*	19 *2*	4089.2	35/2⁺	3338.1	31/2⁺		
785.9 *4*	12 *1*	4457.7	37/2⁺	3671.8	33/2⁺		
787.67 *25*	3.0 *6*	4059.5	33/2⁺	3271.9	29/2⁺		
796[&] *1*	8 *3*	3911.0	(35/2)⁻	3114.9	(31/2)⁻		
803.65 *21*	26 *2*	3609.1	35/2⁻	2805.4	31/2⁻		
824.7[&] *3*	3.0 *6*	4480.0	35/2⁺	3655.3	31/2⁺		E_γ: in the level scheme of 1991Re03 $E\gamma$=811.3 *15*.
832.30 *24*	16 *2*	4180.8	37/2⁻	3348.5	33/2⁻		
838.4 *5*	15 *2*	4927.6	39/2⁺	4089.2	35/2⁺		
862[&] *1*	≈4	4773.0	(39/2)⁻	3911.0	(35/2)⁻		
865.70 *21*	21 *2*	4474.8	39/2⁻	3609.1	35/2⁻		
866.7[&] *3*	3.5 *7*	4926.2	37/2⁺	4059.5	33/2⁺		E_γ: in the level scheme of 1991Re03 $E\gamma$=825.5 *15*.
879.7 *6*	8.9 *18*	5337.4	41/2⁺	4457.7	37/2⁺		
910[&] *1*	2.0 *5*	5390.0	39/2⁺	4480.0	35/2⁺		E_γ: in the level scheme of 1991Re03 $E\gamma$=868.5 *15*.
910.7 *4*	10 *2*	5838.3	43/2⁺	4927.6	39/2⁺		
916.0 *6*	12 *2*	5096.8	41/2⁻	4180.8	37/2⁻		
934.30 *21*	10 *1*	5409.1	43/2⁻	4474.8	39/2⁻		
946[&] *1*	2.2 *5*	5872.3	41/2⁺	4926.2	37/2⁺		
953.3 *6*	5.7 *15*	6290.7	45/2⁺	5337.4	41/2⁺		
958.5 *5*	9 *3*	6796.8	47/2⁺	5838.3	43/2⁺		
972.0[a] *6*	10[a] *2*	7768.8	51/2⁺	6796.8	47/2⁺		
987.9[a] *8*	7.3[a] *20*	7278.6	49/2⁺	6290.7	45/2⁺		
998.5[a] *7*	8[a] *2*	8767.3	55/2⁺	7768.8	51/2⁺		
1003[&] *1*	8 *2*	6099.8	45/2⁻	5096.8	41/2⁻		E_γ: in the level scheme of 1991Re03 $E\gamma$=988.4 *7*.
1004.9 *7*	9 *1*	6414.0	47/2⁻	5409.1	43/2⁻		
1011.9[a] *10*	5.3[a] *20*	8290.5	53/2⁺	7278.6	49/2⁺		
1037.5[a] *12*	5.3[a] *20*	7137.3	49/2⁻	6099.8	45/2⁻		
1071.0[a] *15*	4[a] *2*	9361.5	57/2⁺	8290.5	53/2⁺		

Continued on next page (footnotes at end of table)

^{96}Ru(^{40}Ca,3pγ) 1996Ga17 (continued)

γ(^{133}Pm) (continued)

E_γ [†]	I_γ [‡]	E_i(level)	J^π_i	E_f	J^π_f
1078.1 *7*	5 *1*	7492.1	51/2$^-$	6414.0	47/2$^-$
1154.5 *14*	3.7 *6*	8646.6	55/2$^-$	7492.1	51/2$^-$
1231.1[a] *15*	2.7[a] *20*	9877.7	59/2$^-$	8646.6	55/2$^-$

† Weighted averages of values from 1996Ga17 and 1991Re03, except as noted; when $\Delta E\gamma$ is not shown in Table 1 of 1996Ga17, evaluators assigned $\Delta E\gamma$=0.3 keV.

‡ From 1996Ga17, except as noted.

From DCO values. R(DCO)=$I_{\gamma\gamma}(\pm37°,\pm37°)/I\gamma\gamma(\pm79',\pm79')$. For stretched E2 (Q) transitions DCO ratios are 1.99; for M1+E2, ΔJ=1 transition DCO≈1.0 (1996Ga17).

@ From $\gamma\gamma(\theta)$ (1996Ga17).

& From 1996Ga17.

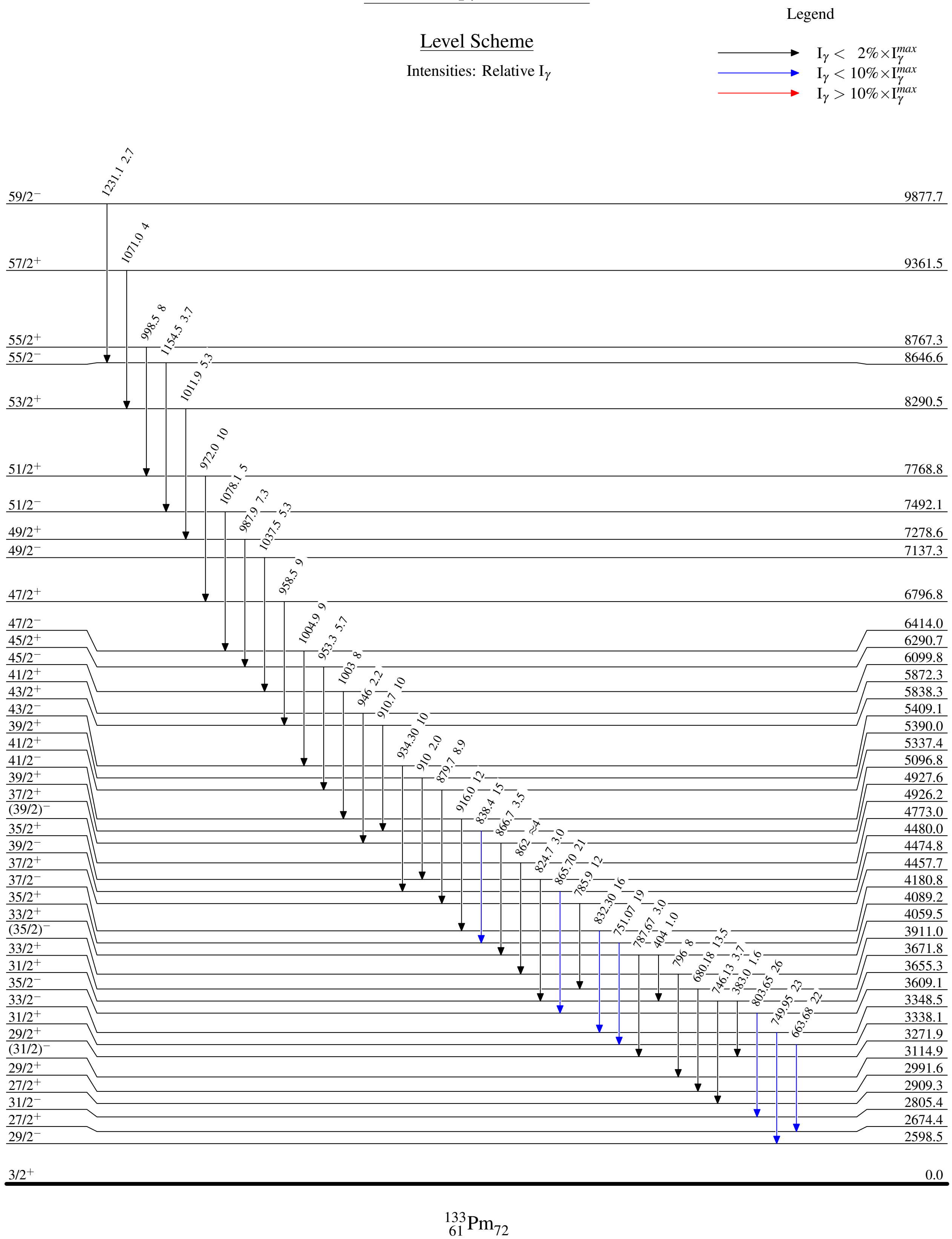
a From 1991Re03; $I\gamma'$s were fit to 1996Ga17 values (divided by 1.5). About 20% of $I\gamma$ values of 1991Re03 have a discrepancy in 2 / 3 times as against $I\gamma$ of 1996Ga17.

b The transition, measured in 1996Ga17 and linking the band C and the band E, must change parity, since the parities of these bands are established in 1991Re03. One may assume that any M2 mixing would be extremely weak, since this transition competes with collective E2 transition in the band C. Therefore, the DCO value are compatible with ΔJ=0 for these transition but not with ΔJ=1.

^{96}Ru(^{40}Ca,3pγ) 1996Ga17

Level Scheme

Intensities: Relative I_γ



^{96}Ru(^{40}Ca,3pγ) 1996Ga17

Level Scheme (continued)

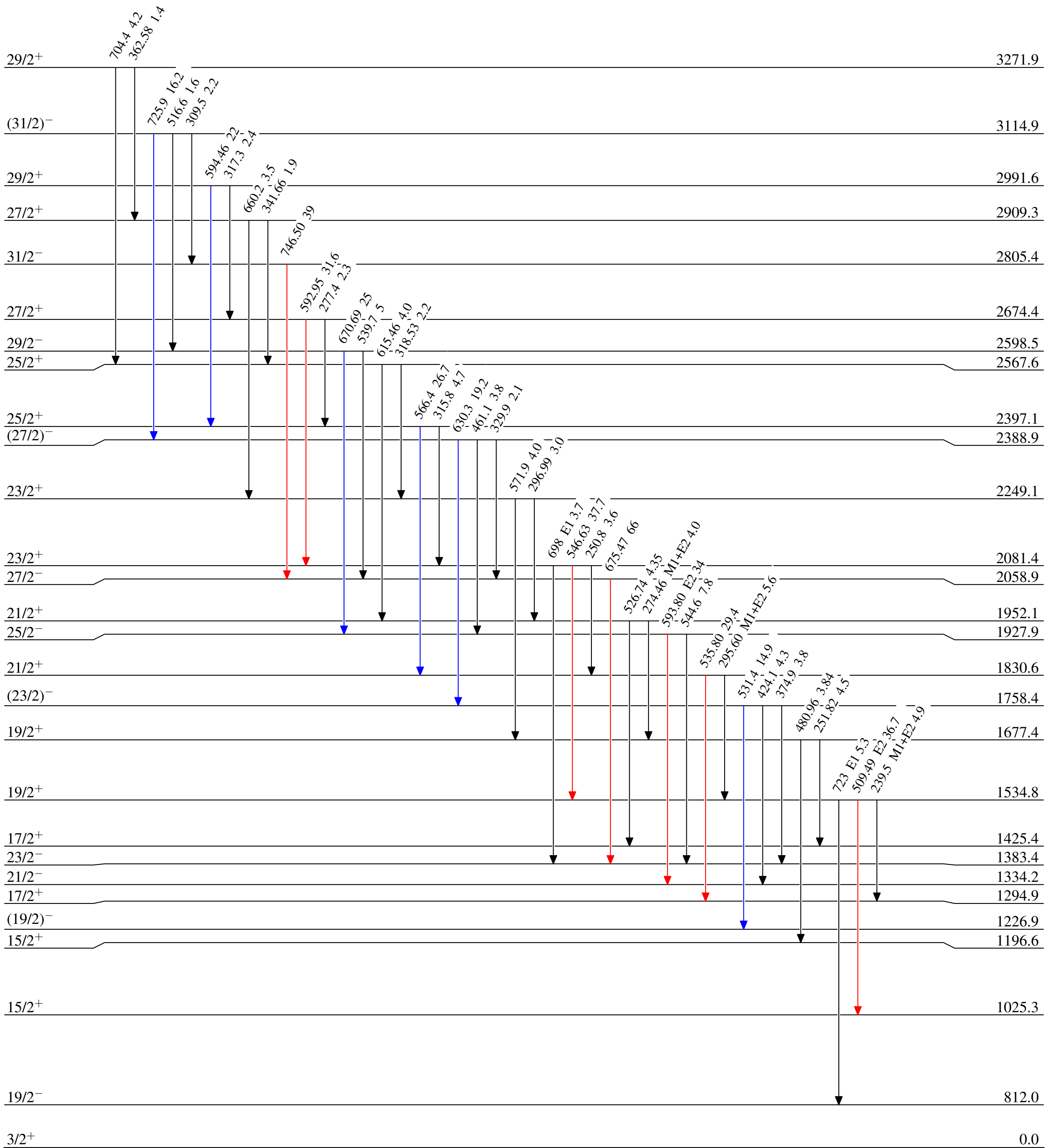
Intensities: Relative I_γ

Legend

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

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

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

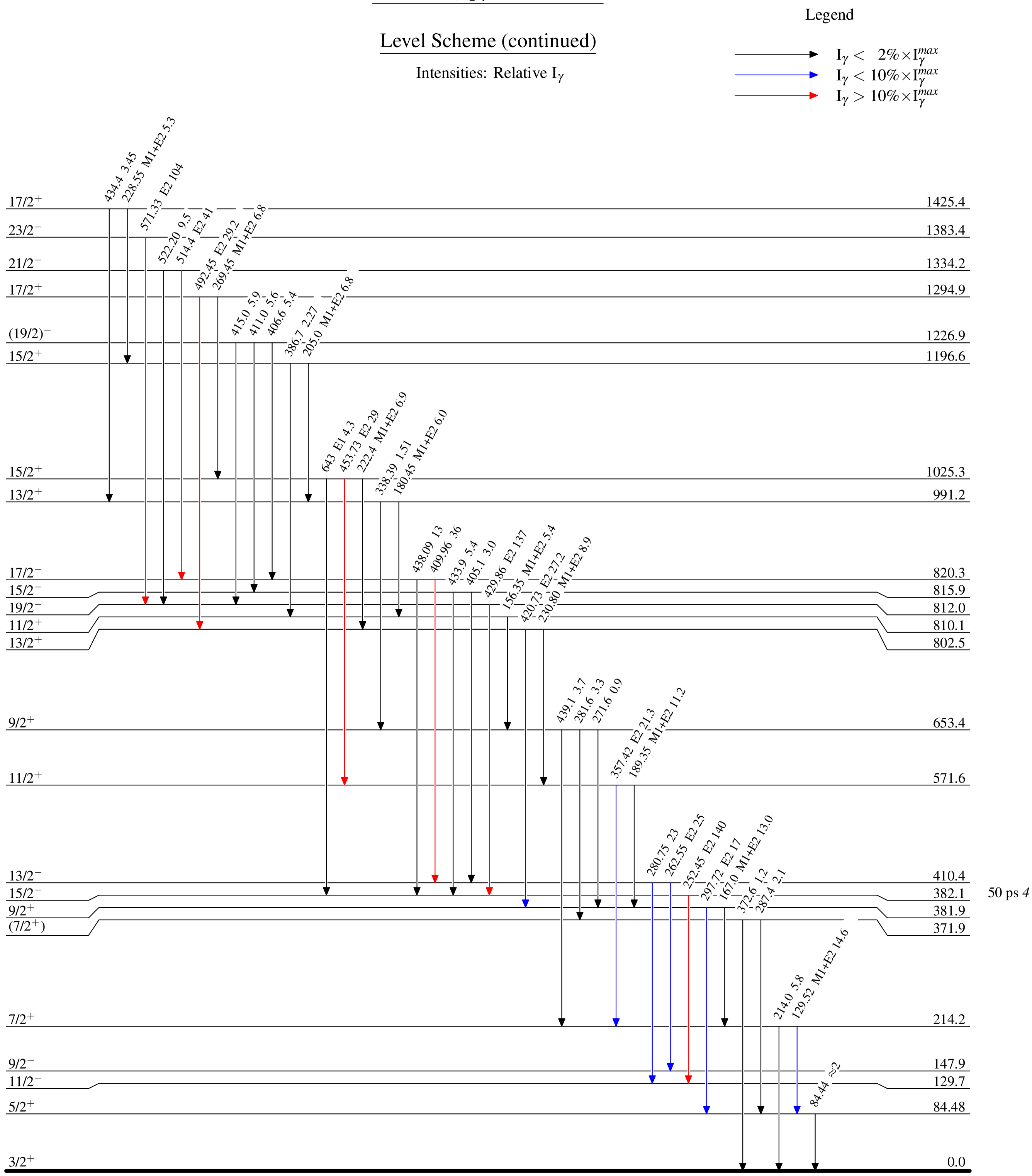


$^{133}_{61}Pm_{72}$

^{96}Ru(^{40}Ca,3pγ)   1996Ga17

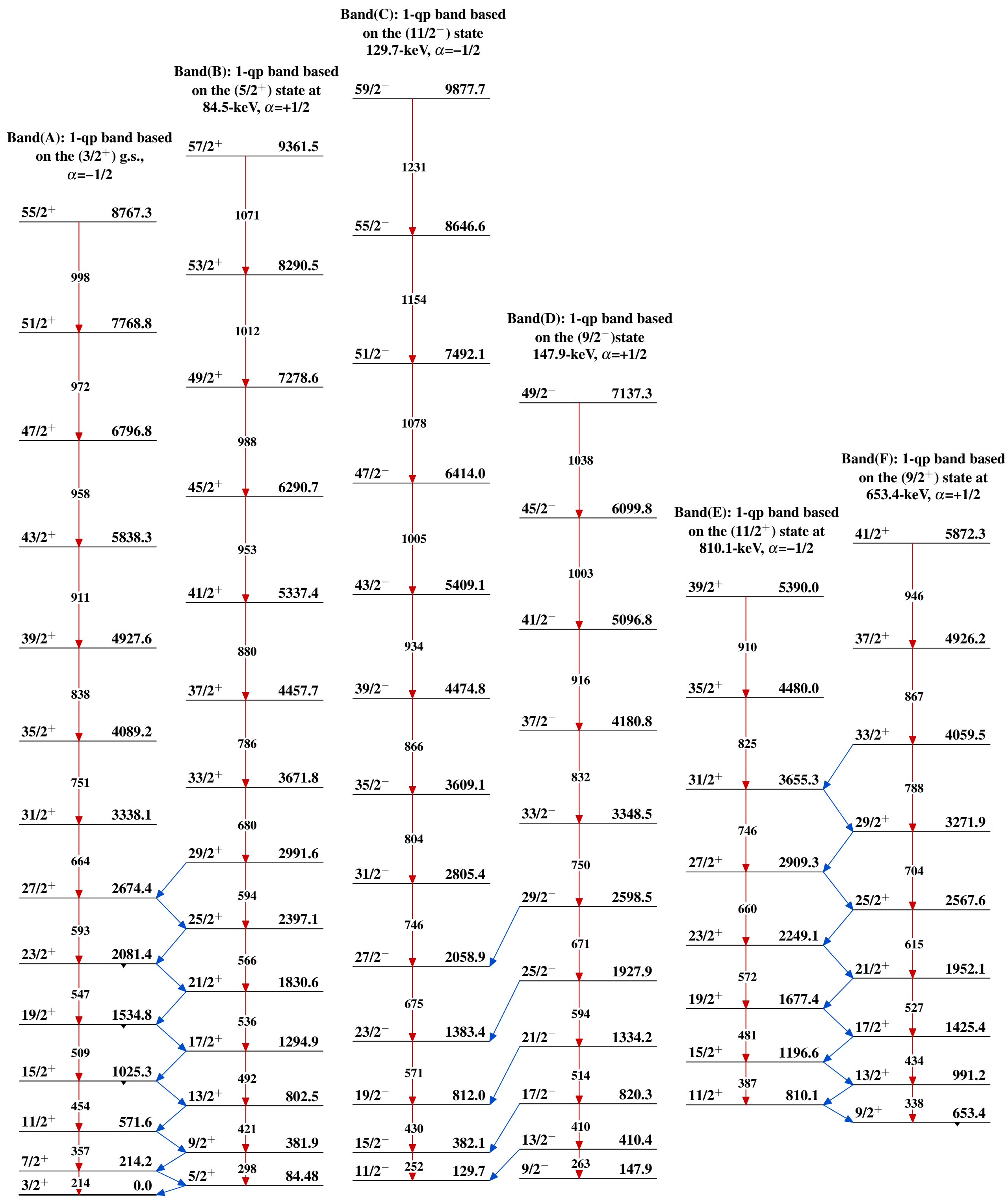
Level Scheme (continued)

Intensities: Relative I_γ



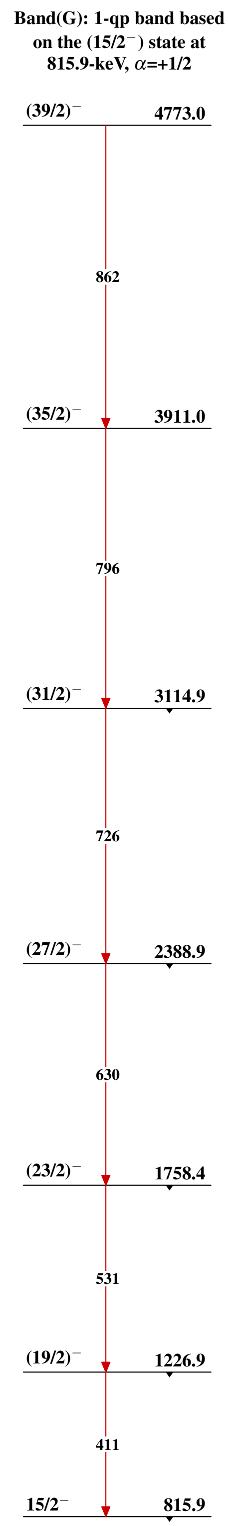
$^{133}_{61}Pm_{72}$

$^{96}Ru(^{40}Ca,3p\gamma)$ 1996Ga17



$^{133}_{61}Pm_{72}$

$^{96}Ru(^{40}Ca,3p\gamma)$ 1996Ga17 (continued)



$^{133}_{61}Pm_{72}$