^{156}Gd(^{36}Ar,4nγ) 1993He05,1999Le61,2004Dr04

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	F. G. Kondev, S. Juutinen, D. J. Hartley	NDS 150, 1 (2018)	1-Feb-2018

1993He05 (also 1993He02): E=175 MeV. Measured Eγ, Iγ, x-γ coin, γγ, recoil-γγ coin., γγ(θ) (DCO) and delayed γ using an 11-detector γ-detector array.

1999Le61: E=172 MeV. Measured Eγ, γγ and E(ce) using four clover Ge detectors and the ICEMOS set up of three mini-orange spectrometers.

2004Dr04 (and 2003Dr02:) E=174 MeV. Measured Eγ, Iγ, γγ, γ(θ), γγ(θ), γγ(t) with the GAMMASPHERE array of 101 Compton-suppressed Ge detectors.

Earlier (and less complete) level schemes are consistent with that of 2004Dr04.

Other: 2000By02 using ^{155}Gd(^{36}Ar,3nγ), ^{157}Gd(^{36}Ar,5nγ), E=176 MeV. Deduced $T_{1/2}$.

^{188}Pb Levels

E(level)[†]	Jπ[#]	$T_{1/2}$[‡]	Comments
0.0	0^+		
591.0 *20*	0^+		E(level): From ce data of 1999Le61.
723.58[@] *23*	2^+		
725.0 *20*	0^+		E(level): From ce data of 1999Le61. Level populated 4 % *1* of the intensity of the 2^+ to 0^+ transition (1999Le61).
952.43[&] *24*	2^+		
1063.8[@] *3*	4^+		
1218.9[h] *8*	(1^-)		
1314.9[&] *3*	4^+		
1411.3[g] *4*	(4^+)		
1433.4[@] *3*	6^+		
1516.8[h] *4*	3^-		
1786.2[&] *4*	6^+		
1787.9[g] *3*	5^+		
1867.3[@] *4*	8^+		
1956.1[h] *4*	5^-		
2138.0 *5*	(6^+)		
2210.5[e] *4*	(5^-)		
2217.0[g] *4*	7^+		
2299.1[&] *4*	8^+		
2366.2[@] *4*	10^+		
2448.5 *4*	(6^-)		
2464.6 *8*			E(level): From 1999Le61.
2474.0[h] *4*	7^-		
2516.0[e] *4*	7^-		
2577.2[a] *4*	8^-	800 ns *20*	$T_{1/2}$: Other: 797 ns *21* from sum of 723γ, 340γ, 370γ, 434γ and 360γ(t) in 2000By02 (^{155}Gd(^{36}Ar,3nγ)). configuration: $K^\pi=8^-$, $\nu(7/2^-[514],9/2^+[624])$ (prolate), supported by comparison of measured g_K-g_R with theoretical predictions.
2663.3 *5*	(8)		
2701.6[c] *5*	11^-	26 ns *3*	configuration: $K^\pi=11^-$, $\pi(9/2^-[505]\otimes13/2^+[606])$ (oblate).
2702.5[g] *4*	(9)		
2709.7[d] *5*	12^+	97 ns *8*	configuration: $\nu(i_{13/2})^{-2}$ (spherical).
2725.1[h] *4*	(9^-)		
2752.2[b] *4*	9^-		

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^{156}Gd(^{36}Ar,4nγ) 1993He05,1999Le61,2004Dr04 (continued)

^{188}Pb Levels (continued)

E(level)[†]	Jπ[#]	$T_{1/2}$[‡]	Comments
2777.9[f] 4	(8⁻)		
2833.3[&] 5	10⁺		
2853.7[e] 4	9⁻		
2923.7[@] 5	12⁺		
2945.2[a] 4	10⁻		
3147.0[b] 5	11⁻		
3165.6[f] 5	(10)		
3183.4 5	11⁻		
3229.2[c] 5	12⁻		
3240.6[g] 5	(11)		
3241.9[e] 5	11⁻		
3389.5[&] 6	12⁺		
3399.3[a] 5	12⁻		
3529.7[@] 5	14⁺		
3617.0[c] 5	13⁻		
3649.8[b] 5	13⁻		
3680.1[e] 5	13⁻		
3699.6[d] 5	14⁺		
3754.5 6	(13⁻)		
3802.4[g] 6	(13)		
3821.2 11	(12)		
3843.9 6	(13⁻)		
3930.4[a] 5	14⁻		
3983.3[&] 7	(14⁺)		
3983.8 6	(13)		
4096.3[c] 5	15⁻		
4136.2 6	(13)		
4163.3[@] 6	16⁺		
4211.8[b] 6	15⁻		
4244.9[d] 5	15⁺		
4250.3 6	(15⁻)		
4294.2 12	(13)		
4389.8? 10			E(level): level not shown in level scheme figures 1 and 2 of 2004Dr04.
4408.9 6	(14⁻)		
4512.4[d] 5	16⁺		
4533.0[a] 6	16⁻		
4565.5[c] 6	17⁻		
4779.9 7	(17)		
4783.3 7	(19⁻)	0.44 μs 6	$T_{1/2}$: from γγγ(t) (2004Dr04). configuration: π(9/2⁻[505],13/2⁺[606])⊗ν(7/2⁺[633],9/2⁺[624]).
4868.1[@] 7	(18⁺)		
5084.1[c] 7	(18⁻)		
5128.3 7	(20⁻)		
5434.9 12	(19)		
5725.3 8	(21⁻)		

† From least-squares fit to Eγ′s.
‡ From Adopted Levels, unless otherwise stated.

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^{156}Gd(^{36}Ar,4nγ) 1993He05,1999Le61,2004Dr04 (continued)

^{188}Pb Levels (continued)

[#] From 2004Dr04, unless otherwise stated.
[@] Band(A): K^π=0$^+$, prolate-deformed yrast band.
[&] Band(B): K^π=0$^+$, oblate-deformed band.
[a] Band(C): K^π=8$^-$, ν(7/2$^-$[514],9/2$^+$[624]) (prolate), α=0.
[b] Band(c): K^π=8$^-$, ν(7/2$^-$[514],9/2$^+$[624]) (prolate), α=1.
[c] Band(D): K^π=11$^-$, π(9/2$^-$[505],13/2$^+$[606]) oblate-deformed band.
[d] Band(E): γ cascade based on J^π=12$^+$ $\nu(i_{13/2})^{-2}$ (spherical).
[e] Band(F): (5$^-$) band, possible $\nu(p_{3/2},i_{13/2})$ configuration.
[f] Band(f): (6$^-$) band, possible $\nu(p_{3/2},i_{13/2})$ configuration.
[g] Band(G): possible γ band, α=1.
[h] Band(H): possible K^π=1$^-$ octupole band.

γ(^{188}Pb)

E_γ[†]	I_γ[‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	Comments
103.0 *3*	0.40 *6*	2577.2	8$^-$	2474.0	7$^-$	M1	Mult.: α(exp)=8 *2*.
129 *1*	0.43 *5*	2577.2	8$^-$	2448.5	(6$^-$)	E2	Mult.: α(exp)=2.0 *13*.
174.9 *3*	1.34 *12*	2752.2	9$^-$	2577.2	8$^-$	M1+E2	Mult.: A_2=−0.63 *18*.
189.3 *3*	0.40 *12*	2663.3	(8)	2474.0	7$^-$		
193.0 *3*	1.02 *10*	2945.2	10$^-$	2752.2	9$^-$	M1+E2	Mult.: A_2=−0.72 *17*.
201.6 *3*	0.56 *10*	3147.0	11$^-$	2945.2	10$^-$		
217.8 *3*	0.60 *8*	4783.3	(19$^-$)	4565.5	17$^-$	(E2)	Mult.: A_2=+0.3 *3*, α(exp)=0.23 or 0.51.
228.7 *3*	1.04 *8*	952.43	2$^+$	723.58	2$^+$	E0+E2	Mult.: A_2=−0.33 *15*, α(exp)=2.9 *5*; E0 component inferred from large α(exp) and A_2 implies large E2 component.
238.2 *3*	0.42 *8*	3183.4	11$^-$	2945.2	10$^-$	M1+E2	Mult.: A_2=−0.8 *3*.
250.5 *3*	0.24 *6*	3649.8	13$^-$	3399.3	12$^-$	M1+E2	Mult.: A_2=−0.5 *3*.
250.8 *3*	1.18 *10*	1314.9	4$^+$	1063.8	4$^+$	E0+E2	Mult.: A_2=−0.31 *18*, α(exp)=2.4 *3*; E0 component inferred from large α(exp) and A_2 implies large E2 component.
251.2 *3*	0.60 *18*	2725.1	(9$^-$)	2474.0	7$^-$		
252.2 *3*	0.26 *6*	3399.3	12$^-$	3147.0	11$^-$		
267.5 *3*	1.9 *4*	4512.4	16$^+$	4244.9	15$^+$	M1+E2	Mult.: A_2=−0.39 *20*.
278.2 *3*	1.39 *6*	2577.2	8$^-$	2299.1	8$^+$	E1	Mult.: α(exp)=0.08 *5*.
280.7 *3*	≈0.14	3930.4	14$^-$	3649.8	13$^-$		
298 *1*	1.2 *3*	1516.8	3$^-$	1218.9	(1$^-$)		
305.5 *3*	≈0.3	2516.0	7$^-$	2210.5	(5$^-$)		
318.4 *3*	0.74 *16*	3241.9	11$^-$	2923.7	12$^+$		
329.4 *3*	0.80 *12*	2777.9	(8$^-$)	2448.5	(6$^-$)		
335.4 *3*	8.9 *4*	2701.6	11$^-$	2366.2	10$^+$	E1	Mult.: A_2=−0.16 *8*.
337.6 *3*	0.56 *8*	2853.7	9$^-$	2516.0	7$^-$		
340.2 *3*	83.8 *13*	1063.8	4$^+$	723.58	2$^+$	E2	Mult.: A_2=+0.24 *4*, DCO=0.96 *7* (1993He05), α(K)exp=0.065 *20* (1999Le61).
343.5 *3*	4.6 *4*	2709.7	12$^+$	2366.2	10$^+$	E2	Mult.: A_2=+0.18 *11*.
345.0 *3*	≈0.20	5128.3	(20$^-$)	4783.3	(19$^-$)		
352.6 *3*	0.84 *14*	1786.2	6$^+$	1433.4	6$^+$	E0+E2	Mult.: α(exp)=1.3 *3*; E0 component inferred from large α(exp). An M1 admixture should be expected, if K ≠ 0 for the initial and final states.
354.8 *3*	0.68 *20*	1787.9	5$^+$	1433.4	6$^+$		
360.2 *3*	2.96 *10*	2577.2	8$^-$	2217.0	7$^+$	E1	Mult.: α(exp)<0.05. E_γ: 360.2 and 362.4 form a doublet structure.
362.4 *3*	10.1 *3*	1314.9	4$^+$	952.43	2$^+$	E2	Mult.: A_2=+0.16 *14*. E_γ: 360.2 and 362.4 form a doublet structure.
368.1 *3*	0.68 *14*	2945.2	10$^-$	2577.2	8$^-$	E2	Mult.: A_2=+0.29 *20*.
369.7 *3*	71.7 *12*	1433.4	6$^+$	1063.8	4$^+$	E2	Mult.: A_2=+0.26 *4*, DCO=1.06 *10* (1993He05).

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^{156}Gd(^{36}Ar,4nγ) 1993He05,1999Le61,2004Dr04 (continued)

γ(^{188}Pb) (continued)

E_γ[†]	I_γ[‡]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[#]	Comments
376.6 3	2.8 4	1787.9	5$^+$	1411.3	(4$^+$)	M1+E2	Mult.: A_2=+1.0 4.
380.4[a] 3	≈0.66	2853.7	9$^-$	2474.0	7$^-$		
387.7[&] 3	0.32[&] 6	3165.6	(10)	2777.9	(8$^-$)		
387.7[&] 3	1.82[&] 8	3617.0	13$^-$	3229.2	12$^-$	M1+E2	Mult.: A_2=−0.42 9.
388.1 3	4.0 4	3241.9	11$^-$	2853.7	9$^-$		
394.9 3	0.48 10	3147.0	11$^-$	2752.2	9$^-$		
416.3 3	1.50 18	4096.3	15$^-$	3680.1	13$^-$	E2	Mult.: A_2=+0.31 16.
425.8 3	0.24 6	2725.1	(9$^-$)	2299.1	8$^+$		
429.2 3	7.2 8	2217.0	7$^+$	1787.9	5$^+$		E_γ: 429.2 and 430.6 form a doublet structure.
430.6 3	1.54 20	2217.0	7$^+$	1786.2	6$^+$		E_γ: 429.2 and 430.6 form a doublet structure.
431.2 3	0.50 10	3183.4	11$^-$	2752.2	9$^-$	(E2)	Mult.: A_2≈+0.3.
431.7 3	0.58 8	2299.1	8$^+$	1867.3	8$^+$	E0+E2	Mult.: α(exp)≈0.3; E0 component inferred from large α(exp). An M1 admixture should be expected, if K ≠ 0 for the initial and final states.
433.8 3	74.9 12	1867.3	8$^+$	1433.4	6$^+$	E2	Mult.: A_2=+0.26 4, DCO=1.07 9 (1993He05).
438.4 3	2.6 3	3680.1	13$^-$	3241.9	11$^-$		
439.1 3	2.58 24	1956.1	5$^-$	1516.8	3$^-$	E2	Mult.: A_2=+0.29 20.
451.0 3	1.38 8	3680.1	13$^-$	3229.2	12$^-$	M1+E2	Mult.: A_2=−0.48 12.
454.1 3	0.70 10	3399.3	12$^-$	2945.2	10$^-$		
458.8 3	4.8 3	1411.3	(4$^+$)	952.43	2$^+$	(E2)	Mult.: A_2=+0.23 14.
466.4 3	0.42 6	3649.8	13$^-$	3183.4	11$^-$		
469.2 3	2.42 10	4565.5	17$^-$	4096.3	15$^-$	E2	Mult.: A_2=+0.16 10.
471.5 3	13.3 3	1786.2	6$^+$	1314.9	4$^+$	E2	Mult.: A_2=+0.24 10. E_γ: 471.5γ and 472.9γ from a doublet structure.
472.9 3	2.76 12	1787.9	5$^+$	1314.9	4$^+$		E_γ: 471.5γ and 472.9γ form a doublet structure.
473.0 3	≈0.20	4294.2	(13)	3821.2	(12)		
479.2 3	2.42 10	4096.3	15$^-$	3617.0	13$^-$	E2	Mult.: A_2=+0.26 9.
485.5 3	2.40 12	2702.5	(9)	2217.0	7$^+$		
487.5 3	3.3 4	2853.7	9$^-$	2366.2	10$^+$		
499.0 3	50.1 9	2366.2	10$^+$	1867.3	8$^+$	E2	Mult.: A_2=+0.26 4, DCO=1.10 11 (1993He05).
503.0 3	0.36 8	3649.8	13$^-$	3147.0	11$^-$		
513.0 3	3.02 10	2299.1	8$^+$	1786.2	6$^+$	E2	Mult.: A_2=+0.21 9.
518.0 3	6.0 3	2474.0	7$^-$	1956.1	5$^-$	E2	Mult.: A_2=+0.33 13.
518.6 3	1.18 8	5084.1	(18$^-$)	4565.5	17$^-$	(D)	Mult.: A_2=−0.21 16.
527.5 3	6.80 20	3229.2	12$^-$	2701.6	11$^-$	M1+E2	Mult.: A_2=−0.63 5.
530.9 3	0.42 10	3930.4	14$^-$	3399.3	12$^-$		
534.2 3	3.1 3	2833.3	10$^+$	2299.1	8$^+$	E2	Mult.: A_2=+0.31 5.
538.1 3	1.34 6	3240.6	(11)	2702.5	(9)		
545.2 3	1.06 8	4244.9	15$^+$	3699.6	14$^+$	(M1)	Mult.: A_2=−0.13 19.
546[a] 1	≈0.40	4389.8?		3843.9	(13$^-$)		
556.2 3	0.86 12	3389.5	12$^+$	2833.3	10$^+$		
557.5 3	24.5 6	2923.7	12$^+$	2366.2	10$^+$	E2	Mult.: A_2=+0.37 6, DCO=1.22 16 (1993He05).
561.0 3	1.28 10	2777.9	(8$^-$)	2217.0	7$^+$		
561.8 3	0.48 10	3802.4	(13)	3240.6	(11)		
562.0 3	0.40 12	4211.8	15$^-$	3649.8	13$^-$		
566.6 3	0.32 6	4096.3	15$^-$	3529.7	14$^+$		
570.2 3	1.06 12	4250.3	(15$^-$)	3680.1	13$^-$	(E2)	Mult.: A_2=+0.2 3.
571.1 3	0.60 10	3754.5	(13$^-$)	3183.4	11$^-$		
591[@] 2		591.0	0$^+$	0.0	0$^+$	E0	Mult.: α(K)exp>0.13, K/L=5 1 (1999Le61). Level populated 2-4 % of the intensity of the 2$^+$ to 0$^+$ transition (1999Le61).
591.5 3	10.0 4	1314.9	4$^+$	723.58	2$^+$	E2	Mult.: A_2=+0.39 10.
593.8 3	0.60 20	3983.3	(14$^+$)	3389.5	12$^+$		
597.0 3	≈0.14	5725.3	(21$^-$)	5128.3	(20$^-$)		
602.6 3	0.20 6	4533.0	16$^-$	3930.4	14$^-$		

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^{156}Gd(^{36}Ar,4nγ) 1993He05,1999Le61,2004Dr04 (continued)

γ(^{188}Pb) (continued)

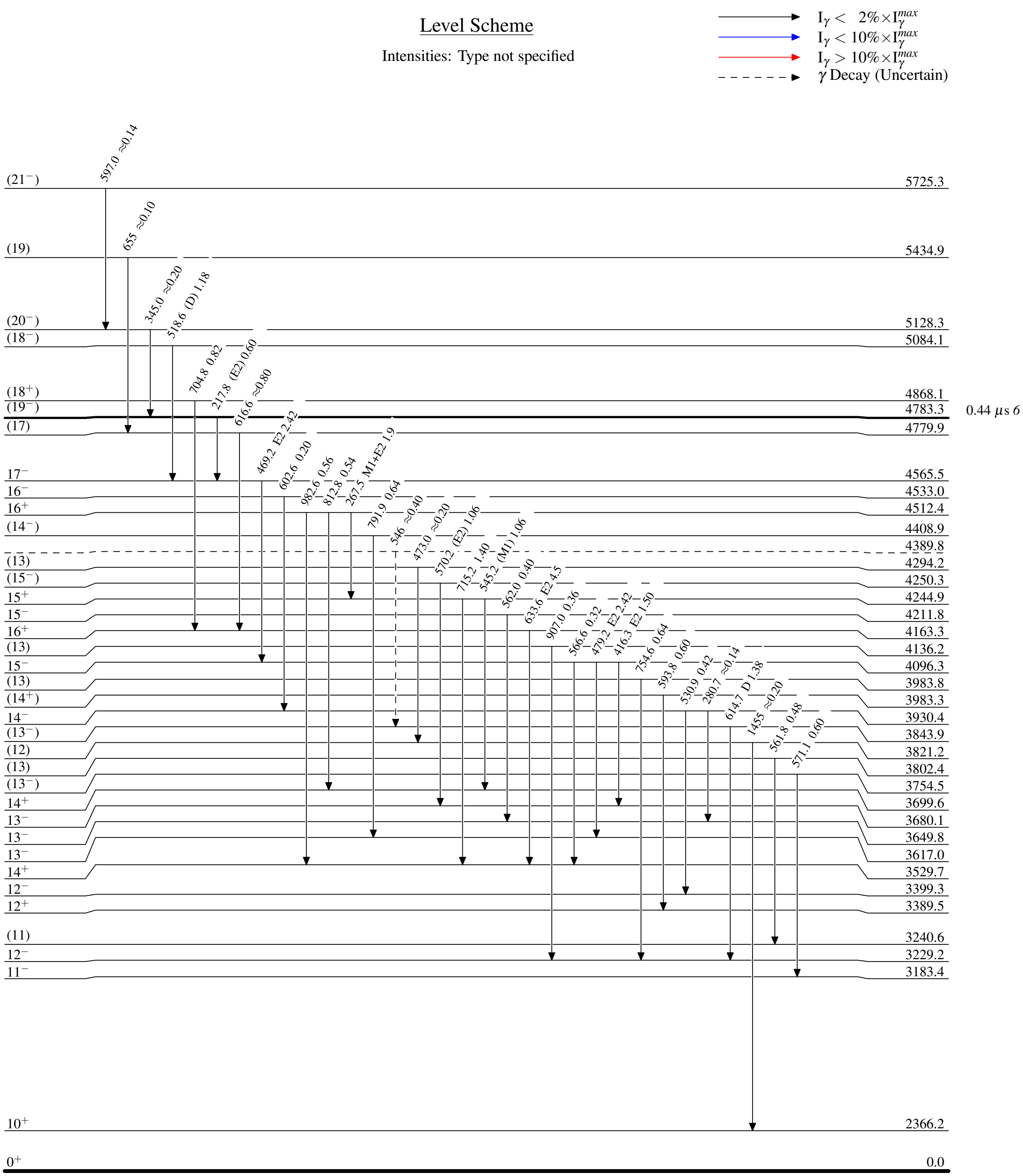
E_γ[†]	I_γ[‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	Comments
606.0 *3*	15.1 *8*	3529.7	14+	2923.7	12+	E2	Mult.: A_2=+0.22 *10*, DCO=1.07 *22* (1993He05).
606.8 *3*	≈0.40	2474.0	7−	1867.3	8+		
614.7 *3*	1.38 *12*	3843.9	(13−)	3229.2	12−	D	Mult.: A_2=−0.4 *2*.
616.6 *3*	≈0.80	4779.9	(17)	4163.3	16+		
633.6 *3*	4.5 *6*	4163.3	16+	3529.7	14+	E2	Mult.: A_2=+0.36 *16*.
648.7 *3*	2.1 *4*	2516.0	7−	1867.3	8+		
655 *1*	≈0.10	5434.9	(19)	4779.9	(17)		
660.5 *3*	2.4 *4*	2448.5	(6−)	1787.9	5+		
688 *1*	≈0.20	2474.0	7−	1786.2	6+		
704.8 *3*	0.82 *16*	4868.1	(18+)	4163.3	16+		
709.9 *3*	1.22 *6*	2577.2	8−	1867.3	8+	[E1]	
715.2 *3*	1.40 *16*	4244.9	15+	3529.7	14+		
723 *1*	1.8 *5*	1786.2	6+	1063.8	4+		
723.5 *3*	100.0	723.58	2+	0.0	0+	E2	Mult.: DCO=0.96 *7* (1993He05).
724 *1*	≈0.40	1787.9	5+	1063.8	4+		
725[@] *2*		725.0	0+	0.0	0+	E0	Mult.: doublet with the strong 723.5γ, 2+ to 0+ transition. α(K)exp=0.044 *5*, K/L=5.4 *10* for the doublet. α(K)=0.0098 expected for E2 (1999Le61).
726.7 *3*	0.52 *10*	2138.0	(6+)	1411.3	(4+)		
754.6 *3*	0.64 *12*	3983.8	(13)	3229.2	12−		
756.2 *3*	0.60 *14*	3680.1	13−	2923.7	12+		
776 *1*	0.66 *14*	3699.6	14+	2923.7	12+		
783.7 *3*	4.0 *4*	2217.0	7+	1433.4	6+	M1+E2	Mult.: A_2=+1.0 *2*.
791.9 *3*	0.64 *12*	4408.9	(14−)	3617.0	13−		
793.1 *3*	3.5 *5*	1516.8	3−	723.58	2+	(E1)	Mult.: A_2=−0.2 *3*.
812.8 *3*	0.54 *16*	4512.4	16+	3699.6	14+		
835.3 *3*	2.4 *4*	2702.5	(9)	1867.3	8+		
866 *1*	0.26 *8*	2299.1	8+	1433.4	6+		
875.7 *3*	1.5 *3*	3241.9	11−	2366.2	10+		
892.4 *3*	4.8 *4*	1956.1	5−	1063.8	4+	(E1)	Mult.: A_2=−0.11 *16*.
907.0 *3*	0.36 *6*	4136.2	(13)	3229.2	12−		
915.5 *3*	3.10 *14*	3617.0	13−	2701.6	11−	E2	Mult.: A_2=+0.22 *9*.
952.5 *3*	11.1 *3*	952.43	2+	0.0	0+		
978.6 *3*	1.06 *8*	3680.1	13−	2701.6	11−	E2	Mult.: A_2=+0.31 *20*.
982.6 *3*	0.56 *16*	4512.4	16+	3529.7	14+		
986.5 *3*	1.24 *14*	2853.7	9−	1867.3	8+		
989.9 *3*	2.56 *14*	3699.6	14+	2709.7	12+	E2	Mult.: A_2=+0.32 *12*.
1015 *1*	0.84 *12*	2448.5	(6−)	1433.4	6+		
1031 *1*		2464.6		1433.4	6+		E_γ: From 1999Le61.
1040 *1*	≈1.20	2474.0	7−	1433.4	6+		
1146.6 *3*	0.88 *14*	2210.5	(5−)	1063.8	4+		
1219 *1*	≈0.80	1218.9	(1−)	0.0	0+		
1401 *1*		2464.6		1063.8	4+		E_γ: From 1999Le61.
1455 *1*	≈0.20	3821.2	(12)	2366.2	10+		

† From 2004Dr04, unless stated otherwise.
‡ From 2004Dr04, normalized to Iγ(723.5)=100.
\# A_2 coefficients, obtained by assuming A_4=0, and α(exp), estimated from intensity balances, are from 2004Dr04. Others from ce data of 1999Le61 and DCO data of 1993He05.
@ From ce data of 1999Le61.
& Multiply placed with intensity suitably divided.
a Placement of transition in the level scheme is uncertain.

^{156}Gd(^{36}Ar,4nγ) 1993He05,1999Le61,2004Dr04

Level Scheme

Intensities: Type not specified

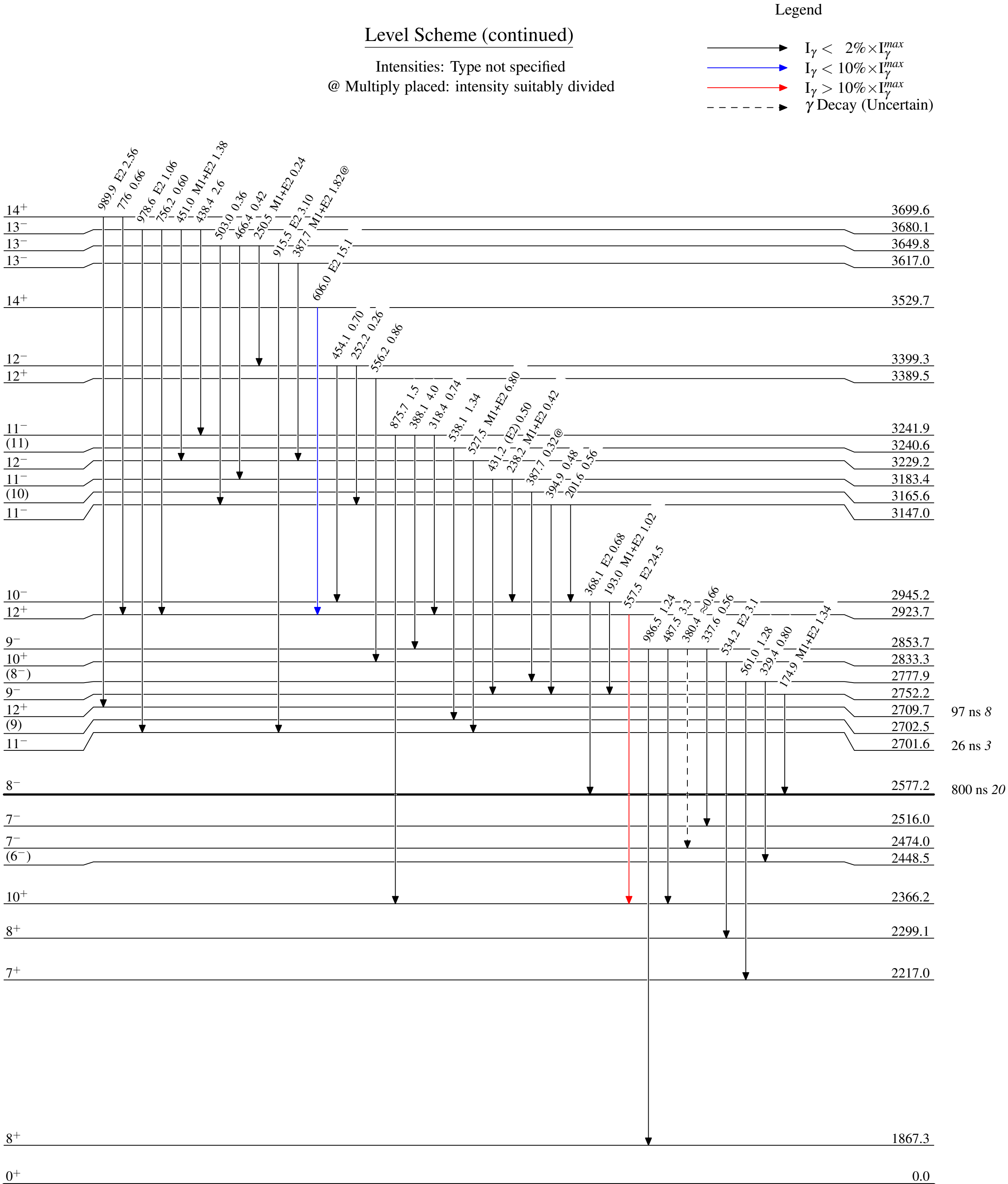


$^{188}_{82}Pb_{106}$

$^{156}Gd(^{36}Ar,4n\gamma)$ 1993He05,1999Le61,2004Dr04

Level Scheme (continued)

Intensities: Type not specified
@ Multiply placed: intensity suitably divided



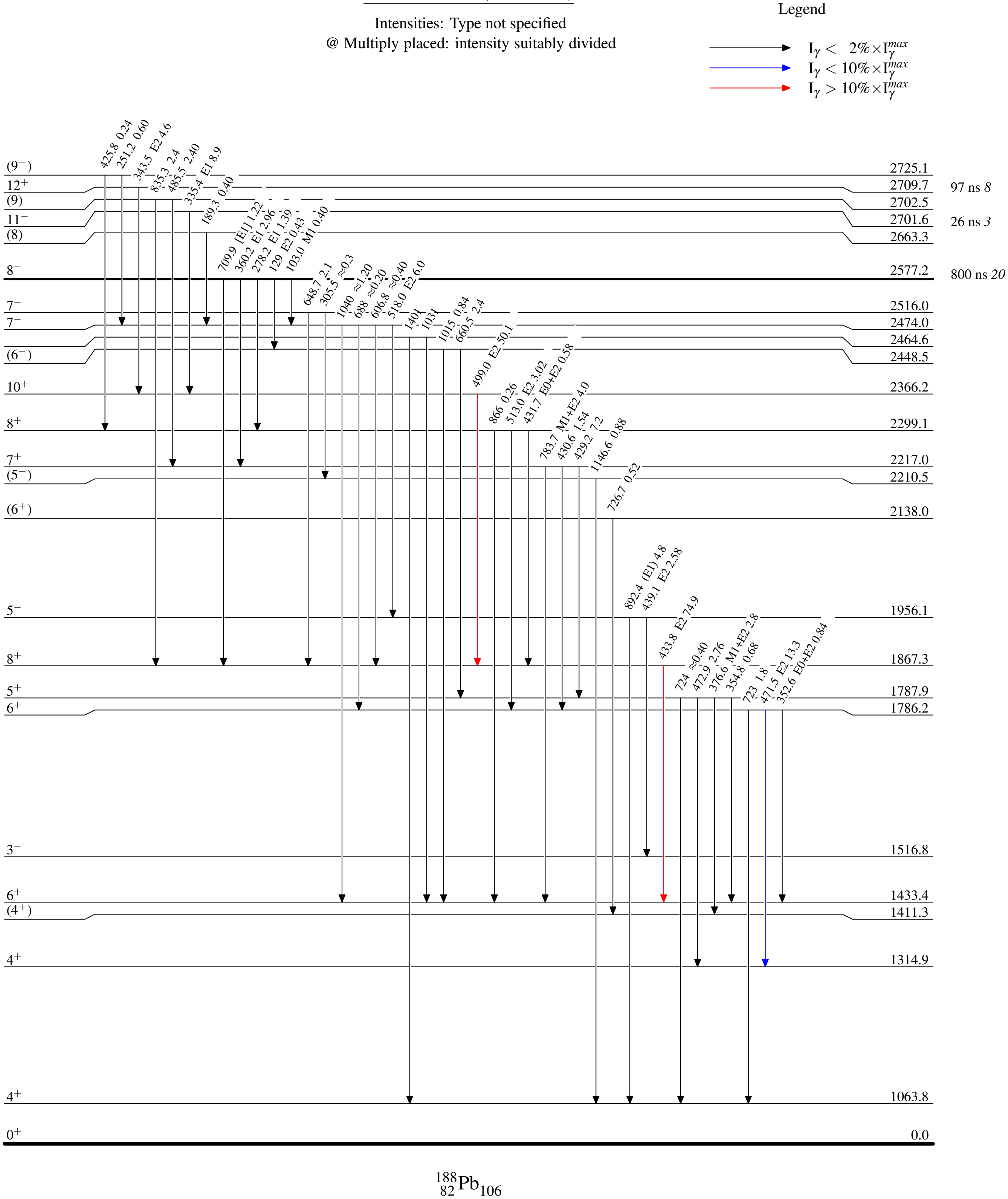
$^{188}_{82}Pb_{106}$

^{156}Gd(^{36}Ar,4nγ) 1993He05,1999Le61,2004Dr04

Level Scheme (continued)

Intensities: Type not specified

@ Multiply placed: intensity suitably divided

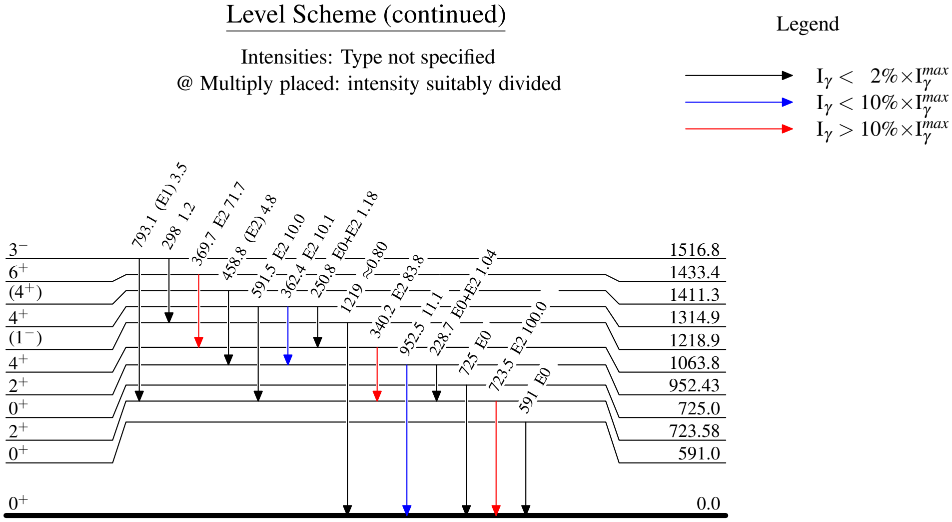


^{156}Gd(^{36}Ar,4nγ) 1993He05,1999Le61,2004Dr04

Level Scheme (continued)

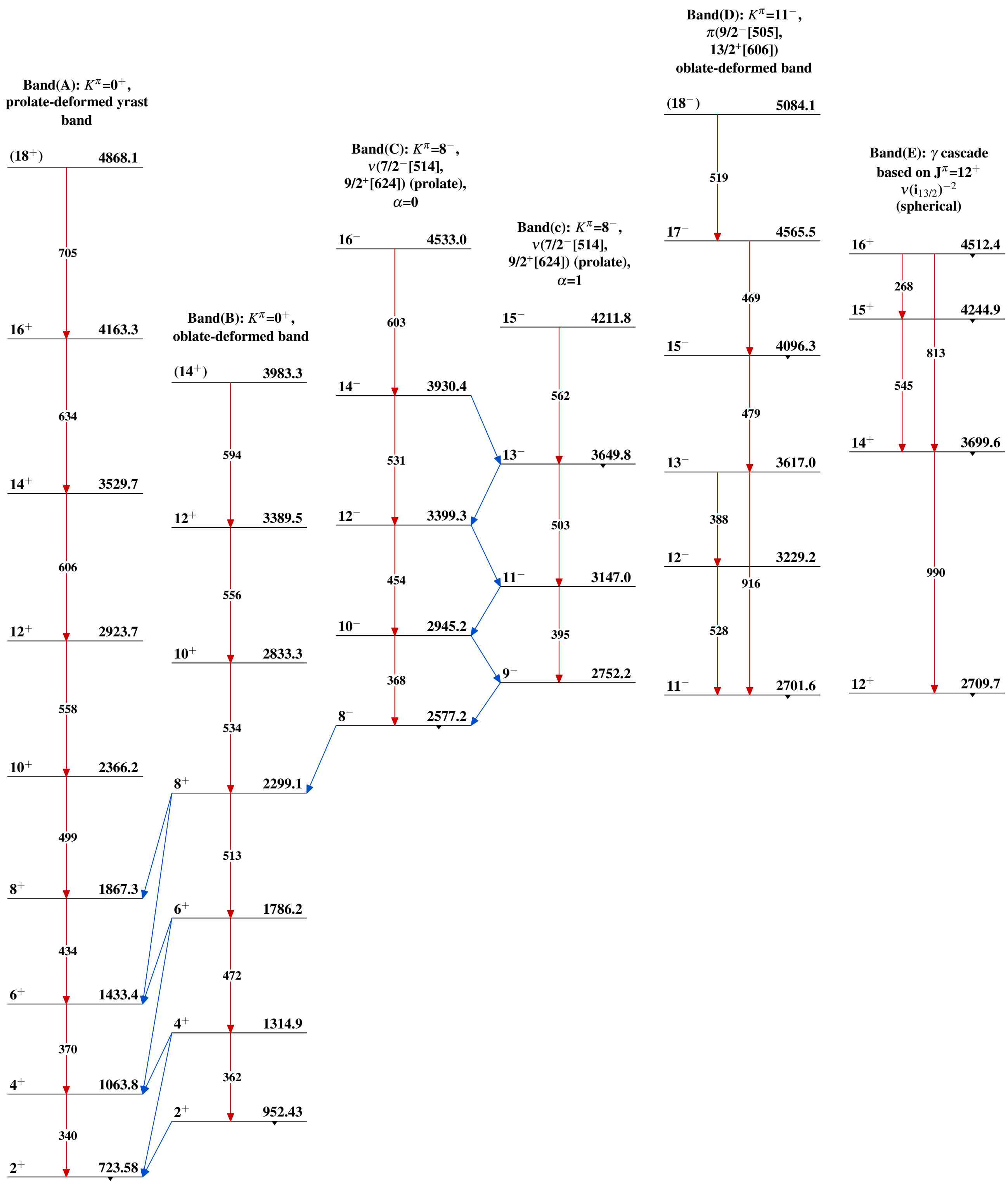
Intensities: Type not specified

@ Multiply placed: intensity suitably divided



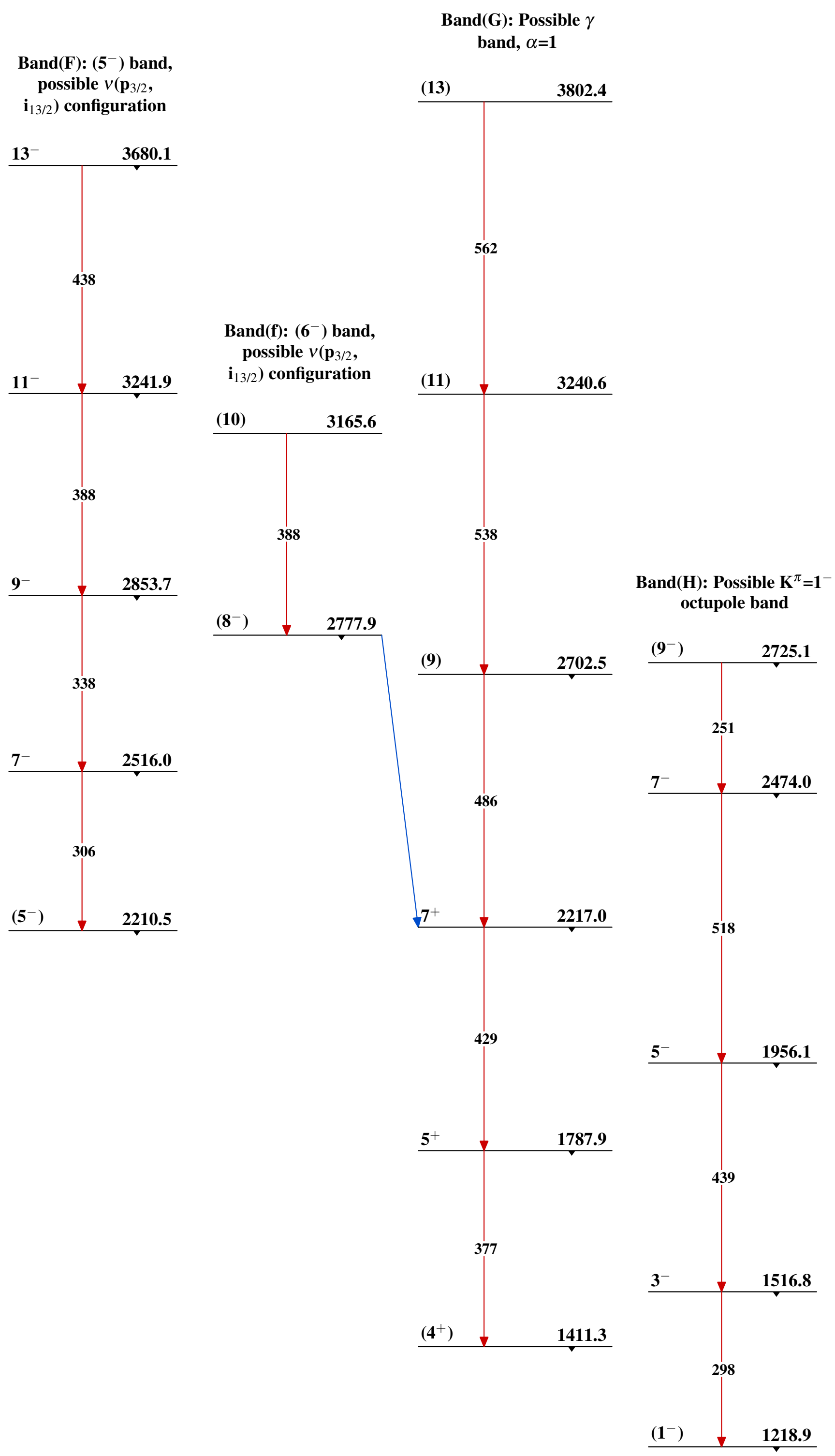
$^{188}_{82}Pb_{106}$

^{156}Gd(^{36}Ar,4nγ) 1993He05,1999Le61,2004Dr04



$^{188}_{82}Pb_{106}$

$^{156}Gd(^{36}Ar,4n\gamma)$ 1993He05,1999Le61,2004Dr04 (continued)



$^{188}_{82}Pb_{106}$