^{106}Cd(^{60}Ni,3pγ) 2009Sa49

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	C. W. Reich, Balraj Singh	NDS 111, 1211 (2010)	12-Apr-2010

Additional information 1.

2009Sa49: E=270 MeV; gas-filled recoil separator RITU, JUROGAM array of 43 EUROGAM-type escape-suppressed Ge detectors, GREAT spectrometer at Jyvaskyla. Measured Eγ, Iγ, $\gamma\gamma$, (recoil)$\gamma\gamma$ coin, (recoil)$\alpha\alpha\alpha\gamma$ coin, $\gamma\gamma(\theta)$(DCO). Recoil-decay tagging technique. Enriched target. Comparison with cranked-shell model and total Routhian surface (TRS) calculations.

An α peak at 4630 keV from ^{163}Ta α decay was seen. Using %α=0.2 branching, cross section for 3p channel was determined to be $\approx$70 mb.

^{163}Ta Levels

Quasiparticle notation for band assignments:

A: ν1/2[660],α=+1/2 from $i_{13/2}$ orbital.
B: ν1/2[660],α=−1/2 from $i_{13/2}$ orbital.
C: ν3/2[651],α=+1/2 from $i_{13/2}$ orbital.
D: ν3/2[651],α=−1/2 from $i_{13/2}$ orbital.
E: ν5/2[523],α=+1/2 from $h_{9/2}$,$f_{7/2}$ orbitals.
F: ν5/2[523],α=−1/2 from $h_{9/2}$,$f_{7/2}$ orbitals.
a: π1/2[411],α=+1/2 from $d_{3/2}$ orbital.
b: π1/2[411],α=−1/2 from $d_{3/2}$ orbital.
c: π7/2[404],α=+1/2 from $g_{7/2}$ orbital.
d: π7/2[404],α=−1/2 from $g_{7/2}$ orbital.
e: π9/2[514],α=−1/2 from $h_{11/2}$ orbital.
f: π9/2[514],α=+1/2 from $h_{11/2}$ orbital.

E(level)[†]	J$^\pi$[‡]	Comments
0+x[#]	(9/2$^-$)	E(level),J$^\pi$: presumably the same level as fed in the α decay of ^{167}Re g.s. (3.4 s). Additional information 2.
44.9+x[@] *5*	(11/2$^-$)	
333.1+x[#] *4*	(13/2$^-$)	
477.7+x[@] *5*	(15/2$^-$)	
871.2+x[#] *5*	(17/2$^-$)	
1047.0+x[@] *5*	(19/2$^-$)	
1312.7+x[&] *5*	(15/2$^+$)	
1522.4+x[#] *5*	(21/2$^-$)	
1547.5+x[a] *5*	(17/2$^+$)	
1717.5+x[@] *5*	(23/2$^-$)	
1725.9+x[&] *5*	(19/2$^+$)	
1946.7+x[a] *5*	(21/2$^+$)	
2171.0+x[&] *5*	(23/2$^+$)	
2248.5+x[#] *5*	(25/2$^-$)	
2303.6+x[b] *5*	(25/2$^+$)	
2410.9+x[a] *5*	(25/2$^+$)	
2422.7+x[c] *6*	(27/2$^+$)	
2458.1+x[@] *5*	(27/2$^-$)	
2583.8+x[b] *6*	(29/2$^+$)	
2798.9+x[c] *6*	(31/2$^+$)	
2952.4+x[#] *6*	(29/2$^-$)	

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$^{106}Cd(^{60}Ni,3p\gamma)$ 2009Sa49 (continued)

^{163}Ta Levels (continued)

E(level)†	Jπ‡	E(level)†	Jπ‡	E(level)†	Jπ‡	E(level)†	Jπ‡
3045.5+x[b] 6	(33/2+)	3759.9+x[#] 6	(37/2−)	4647.5+x[c] 7	(43/2+)	5912.7+x[b] 8	(49/2+)
3094.3+x[@] 6	(31/2−)	3931.7+x[c] 7	(39/2+)	4954.1+x[#] 7	(45/2−)	6017.8+x[@] 8	(51/2−)
3295.2+x[#] 6	(33/2−)	4039.0+x[@] 7	(39/2−)	5085.8+x[b] 8	(45/2+)	6397.8+x[#] 8	(53/2−)
3308.4+x[c] 7	(35/2+)	4319.2+x[b] 7	(41/2+)	5293.6+x[@] 7	(47/2−)	6799.7+x[@] 8	(55/2−)
3515.6+x[@] 6	(35/2−)	4322.5+x[#] 7	(41/2−)	5436.5+x[c] 8	(47/2+)	7213.4+x[#] 8	(57/2−)
3630.6+x[b] 7	(37/2+)	4628.7+x[@] 7	(43/2−)	5647.8+x[#] 7	(49/2−)		

† From least-squares fit to Eγ′s.

‡ As proposed by 2009Sa49, based on observation of band structures, DCO ratios for selected transitions, systematics and comparison with cranked shell-model calculations. Note that the authors state that their J^π assignments are regarded as tentative. Thus the evaluators give all the assignments in parentheses.

Band(A): Band f to fAB,α=+1/2. Strongly-coupled band built on π9/2[514] Nilsson orbital. This band starts as a 1-qp band but is crossed by a 3-qp band fAB at $J^\pi \approx 31/2^-$ and $\hbar\omega$≈0.28 MeV. Calculated β_2=0.177, γ=−15° for low-spin states and β_2=0.170, γ=0° for high-spin states above the backbend.

@ Band(a): Band e to eAB, α=−1/2. Strongly-coupled band built on π9/2[514] Nilsson orbital. This band starts as a 1-qp band but is crossed by a 3-qp band fAB at $J^\pi \approx 31/2^-$ and $\hbar\omega$≈0.28 MeV See also comments for α=+1/2 partner.

& Band(B): Possible π9/2[514]⊗3$^-$,α=−1/2. Strongly coupled-band, possible 3$^-$ octupole vibrational band built on π9/2[514], as supported by the relatively large alignment of the band and the relatively low excitation energy of the bandhead. Further pure dipole (possible E1) transition to the yrast band also supports the octupole character of the band.

a Band(b): Possible π9/2[514]#3$^-$,α=+1/2. See comments for α=−1/2 partner.

b Band(C): Band fAE, α=+1/2.

c Band(c): Band eAE, α=−1/2.

$\gamma(^{163}Ta)$

DCO values correspond to 94° and 158° geometry and gates on ΔJ=2, quadrupole transitions. Expected values of DCO are: ≈1.0 for ΔJ=2, quadrupole, ≈0.5 for ΔJ=1, dipole.

Eγ	Iγ	Ei(level)	Jπi	Ef	Jπf	Mult.†	Comments
(45)		44.9+x	(11/2−)	0+x	(9/2−)		
118.6 3	26.4 7	2422.7+x	(27/2+)	2303.6+x	(25/2+)	D+Q	DCO=0.76 21
131.9 3	31.6 8	2303.6+x	(25/2+)	2171.0+x	(23/2+)	D+Q	DCO=0.76 19
141.6 4	10.0 3	3094.3+x	(31/2−)	2952.4+x	(29/2−)		
144.2 3	34.0 7	477.7+x	(15/2−)	333.1+x	(13/2−)	D+Q	DCO=0.73 10
161.1 4	24.4 8	2583.8+x	(29/2+)	2422.7+x	(27/2+)	D+Q‡	DCO=0.98 17
175.9 4	9.2 4	1047.0+x	(19/2−)	871.2+x	(17/2−)	D+Q	DCO=0.71 11
178.5 4	3.2 5	1725.9+x	(19/2+)	1547.5+x	(17/2+)		
195.1 2	4.4 5	1717.5+x	(23/2−)	1522.4+x	(21/2−)		
201.0 3	30.4 10	3295.2+x	(33/2−)	3094.3+x	(31/2−)	D+Q	DCO=0.70 8
209.8 2	4.4 5	2458.1+x	(27/2−)	2248.5+x	(25/2−)		
215.2 4	23.2 7	2798.9+x	(31/2+)	2583.8+x	(29/2+)	D+Q	DCO=0.75 18
220.4 2	30.0 9	3515.6+x	(35/2−)	3295.2+x	(33/2−)	D+Q	DCO=0.81 10
221.1 3	8.4 3	1946.7+x	(21/2+)	1725.9+x	(19/2+)		
224.6 4	21.6 7	2171.0+x	(23/2+)	1946.7+x	(21/2+)	D+Q‡	DCO=0.93 14
235.1 5	1.2 5	1547.5+x	(17/2+)	1312.7+x	(15/2+)		
240.1 3	9.2 7	2410.9+x	(25/2+)	2171.0+x	(23/2+)		

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^{106}Cd(^{60}Ni,3pγ) 2009Sa49 (continued)

γ(^{163}Ta) (continued)

E_γ	I_γ	E_i(level)	J^π_i	E_f	J^π_f	Mult.†	Comments
244.3 3	28.0 7	3759.9+x	(37/2⁻)	3515.6+x	(35/2⁻)	D+Q	DCO=0.66 9
246.6 3	20.8 6	3045.5+x	(33/2⁺)	2798.9+x	(31/2⁺)		
252.1 3	2.4 3	2422.7+x	(27/2⁺)	2171.0+x	(23/2⁺)		
262.9 4	19.2 4	3308.4+x	(35/2⁺)	3045.5+x	(33/2⁺)		
279.1 2	20.8 8	4039.0+x	(39/2⁻)	3759.9+x	(37/2⁻)		
280.3 5	4.0 5	2583.8+x	(29/2⁺)	2303.6+x	(25/2⁺)		
283.4 2	19.8 7	4322.5+x	(41/2⁻)	4039.0+x	(39/2⁻)		
288.1 3	100.0 13	333.1+x	(13/2⁻)	44.9+x	(11/2⁻)	Q	DCO=0.86 8
301.1 4	10.8 6	3931.7+x	(39/2⁺)	3630.6+x	(37/2⁺)		
306.3 3	15.2 7	4628.7+x	(43/2⁻)	4322.5+x	(41/2⁻)		
322.3 3	13.2 5	3630.6+x	(37/2⁺)	3308.4+x	(35/2⁺)		
325.0 3	11.2 8	4954.1+x	(45/2⁻)	4628.7+x	(43/2⁻)		
328.4 3	5.2 4	4647.5+x	(43/2⁺)	4319.2+x	(41/2⁺)		
333.1 4	10.0 6	333.1+x	(13/2⁻)	0+x	(9/2⁻)		
339.3 4	4.8 6	5293.6+x	(47/2⁻)	4954.1+x	(45/2⁻)		
342.6 7	1.0 7	3295.2+x	(33/2⁻)	2952.4+x	(29/2⁻)		
350.7 5	1.2 4	5436.5+x	(47/2⁺)	5085.8+x	(45/2⁺)		
355.2 5	6.0 7	5647.8+x	(49/2⁻)	5293.6+x	(47/2⁻)		
357.3 6	2.8 4	2303.6+x	(25/2⁺)	1946.7+x	(21/2⁺)		
370.0 2	4.8 6	6017.8+x	(51/2⁻)	5647.8+x	(49/2⁻)		
376.3 4	2.4 3	2798.9+x	(31/2⁺)	2422.7+x	(27/2⁺)		
379.8 3	2.4 5	6397.8+x	(53/2⁻)	6017.8+x	(51/2⁻)		
387.7 4	7.2 6	4319.2+x	(41/2⁺)	3931.7+x	(39/2⁺)		
393.4 2	46.3 9	871.2+x	(17/2⁻)	477.7+x	(15/2⁻)	D+Q	DCO=0.95 10
399.2 4	2.4 7	1946.7+x	(21/2⁺)	1547.5+x	(17/2⁺)		
402.3 4	<1	6799.7+x	(55/2⁻)	6397.8+x	(53/2⁻)		
413.3 3	2.4 5	1725.9+x	(19/2⁺)	1312.7+x	(15/2⁺)		
414.1 5	1.5 4	7213.4+x	(57/2⁻)	6799.7+x	(55/2⁻)		
421.3 3	5.6 7	3515.6+x	(35/2⁻)	3094.3+x	(31/2⁻)		
432.9 4	88.0 13	477.7+x	(15/2⁻)	44.9+x	(11/2⁻)	Q	DCO=1.01 9
438.2 3	3.2 5	5085.8+x	(45/2⁺)	4647.5+x	(43/2⁺)		
445.2 3	14.0 6	2171.0+x	(23/2⁺)	1725.9+x	(19/2⁺)	Q	DCO=1.00 12 Additional information 3.
461.6 4	7.3 6	3045.5+x	(33/2⁺)	2583.8+x	(29/2⁺)		
464.1 2	2.0 5	2410.9+x	(25/2⁺)	1946.7+x	(21/2⁺)		
464.7 2	6.8 5	3759.9+x	(37/2⁻)	3295.2+x	(33/2⁻)		
475.3 2	21.2 7	1522.4+x	(21/2⁻)	1047.0+x	(19/2⁻)	D+Q	DCO=0.83 12
476.4 3	1.2 4	5912.7+x	(49/2⁺)	5436.5+x	(47/2⁺)		
494.3 2	15.2 4	2952.4+x	(29/2⁻)	2458.1+x	(27/2⁻)		
509.4 3	10.8 7	3308.4+x	(35/2⁺)	2798.9+x	(31/2⁺)		
523.3 4	8.4 3	4039.0+x	(39/2⁻)	3515.6+x	(35/2⁻)		
531.0 2	9.6 8	2248.5+x	(25/2⁻)	1717.5+x	(23/2⁻)		
538.2 3	35.6 9	871.2+x	(17/2⁻)	333.1+x	(13/2⁻)		
562.8 3	10.8 5	4322.5+x	(41/2⁻)	3759.9+x	(37/2⁻)		
569.2 2	79.6 11	1047.0+x	(19/2⁻)	477.7+x	(15/2⁻)	Q	DCO=1.07 8
585.1 4	7.2 5	3630.6+x	(37/2⁺)	3045.5+x	(33/2⁺)		
589.6 3	6.8 4	4628.7+x	(43/2⁻)	4039.0+x	(39/2⁻)		
623.3 3	11.4 6	3931.7+x	(39/2⁺)	3308.4+x	(35/2⁺)		
631.7 4	8.4 3	4954.1+x	(45/2⁻)	4322.5+x	(41/2⁻)		
636.5 4	29.5 9	3094.3+x	(31/2⁻)	2458.1+x	(27/2⁻)	Q	DCO=1.17 12
648.6 3	18.8 6	2171.0+x	(23/2⁺)	1522.4+x	(21/2⁻)	D	DCO=0.61 20
651.2 2	30.0 9	1522.4+x	(21/2⁻)	871.2+x	(17/2⁻)	Q	DCO=1.25 19
665.1 3	6.0 6	5293.6+x	(47/2⁻)	4628.7+x	(43/2⁻)		
670.5 4	54.0 6	1717.5+x	(23/2⁻)	1047.0+x	(19/2⁻)	Q	DCO=1.13 12
688.5 4	6.4 5	4319.2+x	(41/2⁺)	3630.6+x	(37/2⁺)		
693.6 3	3.6 4	5647.8+x	(49/2⁻)	4954.1+x	(45/2⁻)		

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^{106}Cd(^{60}Ni,3pγ) 2009Sa49 (continued)

γ(^{163}Ta) (continued)

E_γ	I_γ	E_i(level)	J_i^π	E_f	J_f^π	Mult.†	Comments
703.9 *4*	14.8 *6*	2952.4+x	(29/2⁻)	2248.5+x	(25/2⁻)		
715.7 *4*	9.6 *6*	4647.5+x	(43/2⁺)	3931.7+x	(39/2⁺)		
723.9 *4*	5.2 *5*	6017.8+x	(51/2⁻)	5293.6+x	(47/2⁻)		
726.3 *3*	13.6 *5*	2248.5+x	(25/2⁻)	1522.4+x	(21/2⁻)		
740.1 *3*	44.4 *10*	2458.1+x	(27/2⁻)	1717.5+x	(23/2⁻)	Q	DCO=1.08 *14*
750.3 *4*	2.0 *3*	6397.8+x	(53/2⁻)	5647.8+x	(49/2⁻)		
766.5 *4*	3.2 *4*	5085.8+x	(45/2⁺)	4319.2+x	(41/2⁺)		
781.8 *5*	1.2 *3*	6799.7+x	(55/2⁻)	6017.8+x	(51/2⁻)		
789.1 *3*	4.8 *5*	5436.5+x	(47/2⁺)	4647.5+x	(43/2⁺)		
815.3 *4*	<1	7213.4+x	(57/2⁻)	6397.8+x	(53/2⁻)		
826.6 *5*	2.4 *4*	5912.7+x	(49/2⁺)	5085.8+x	(45/2⁺)		
854.8 *4*	24.4 *7*	1725.9+x	(19/2⁺)	871.2+x	(17/2⁻)	D	DCO=0.73 *18*
899.6 *3*	22.4 *7*	1946.7+x	(21/2⁺)	1047.0+x	(19/2⁻)	D	DCO=0.69 *14*
979.9 *4*	2.8 *3*	1312.7+x	(15/2⁺)	333.1+x	(13/2⁻)		
1069.7 *3*	6.0 *5*	1547.5+x	(17/2⁺)	477.7+x	(15/2⁻)	D	DCO=0.63 *22*

† From $\gamma\gamma(\theta)$(DCO), mult=Q corresponds to ΔJ=2, quadrupole (most likely E2), mult=D+Q to ΔJ=1, dipole or dipole+quadrupole, the former most likely E1 and the latter M1+E2.

‡ DCO ratio of ≈1 suggests a significant dipole and quadrupole admixture, thus the transition is most likely M1+E2.

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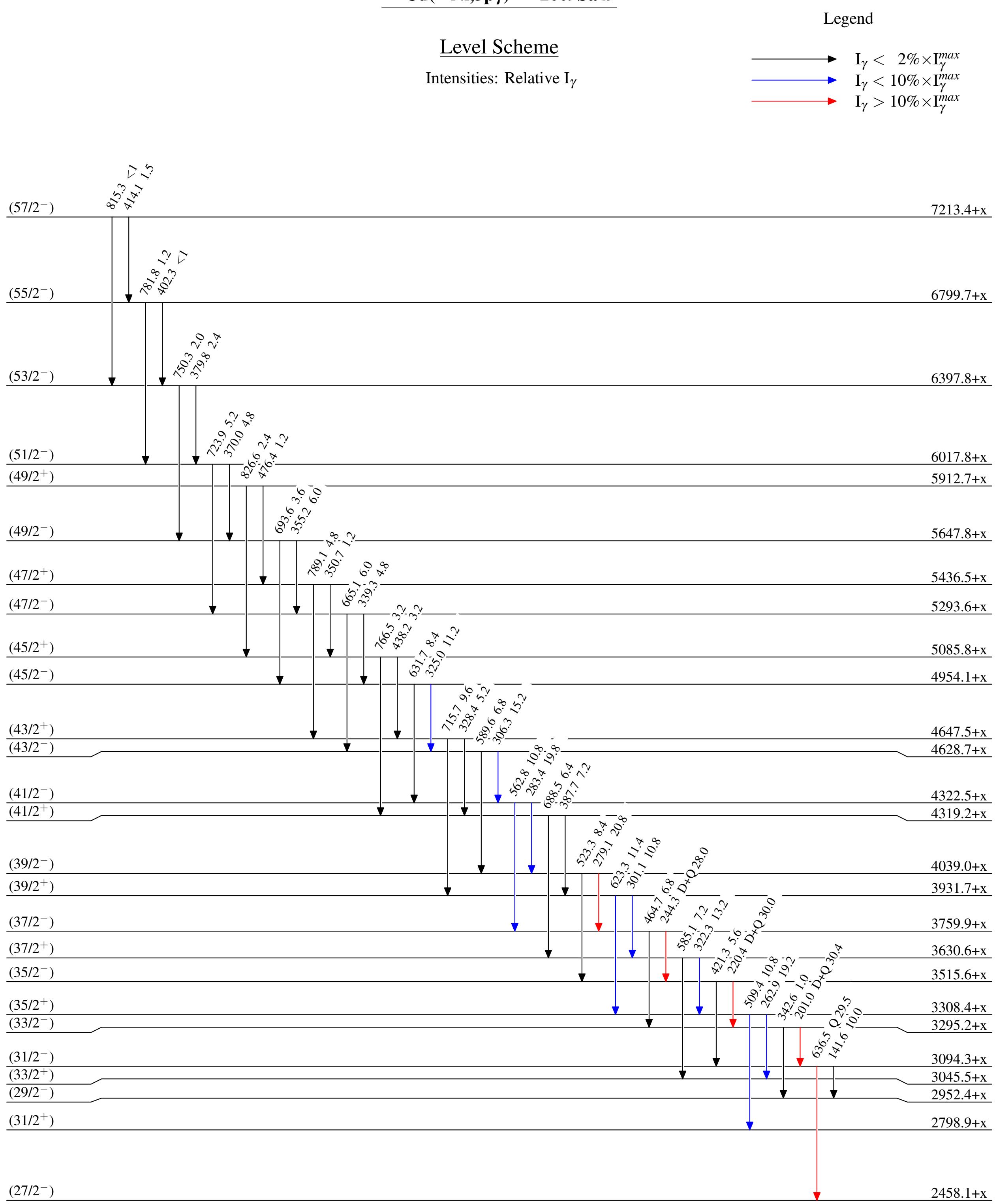
Level Scheme

Intensities: Relative I_γ



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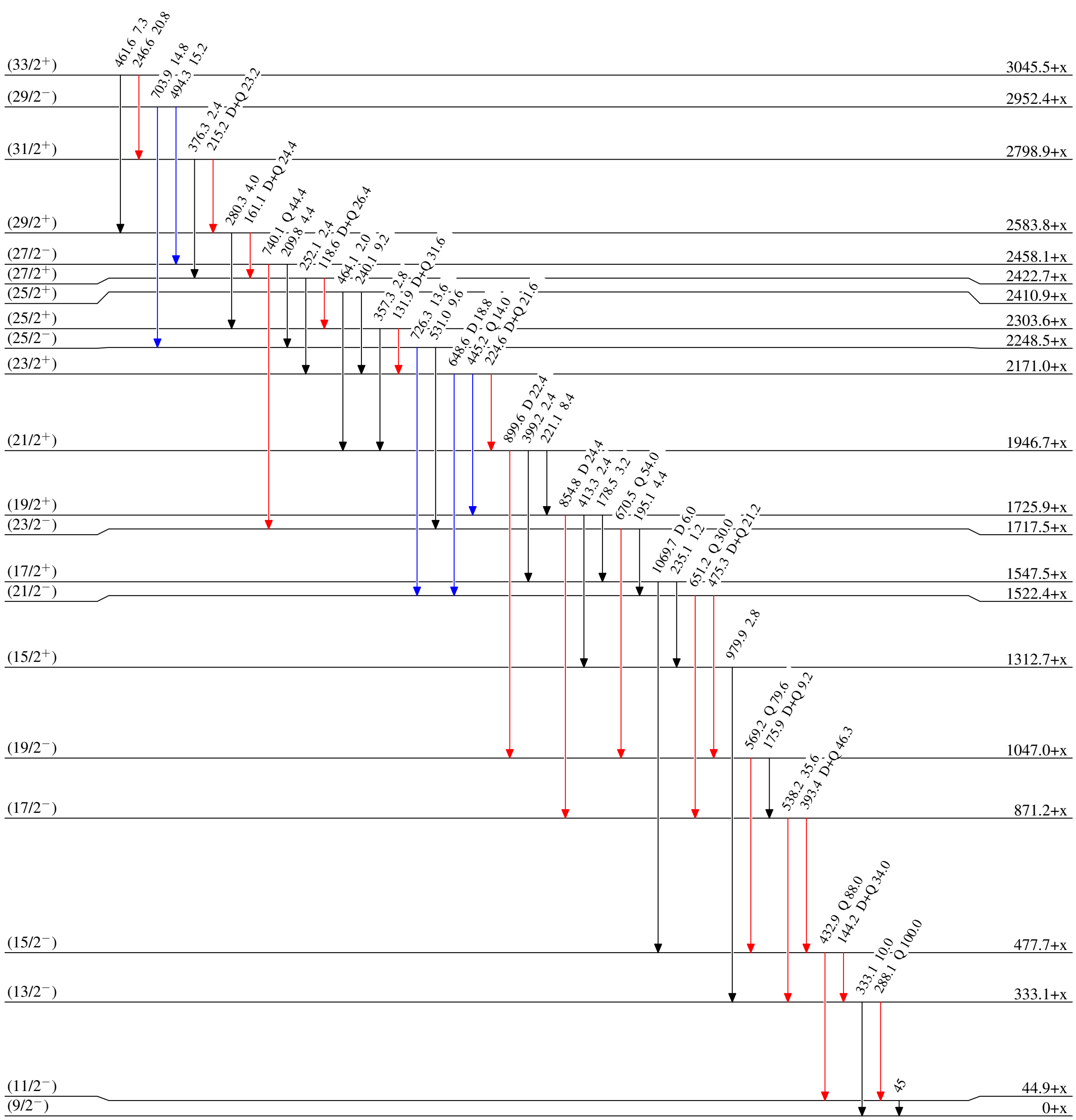
Level Scheme (continued)

Intensities: Relative I_γ



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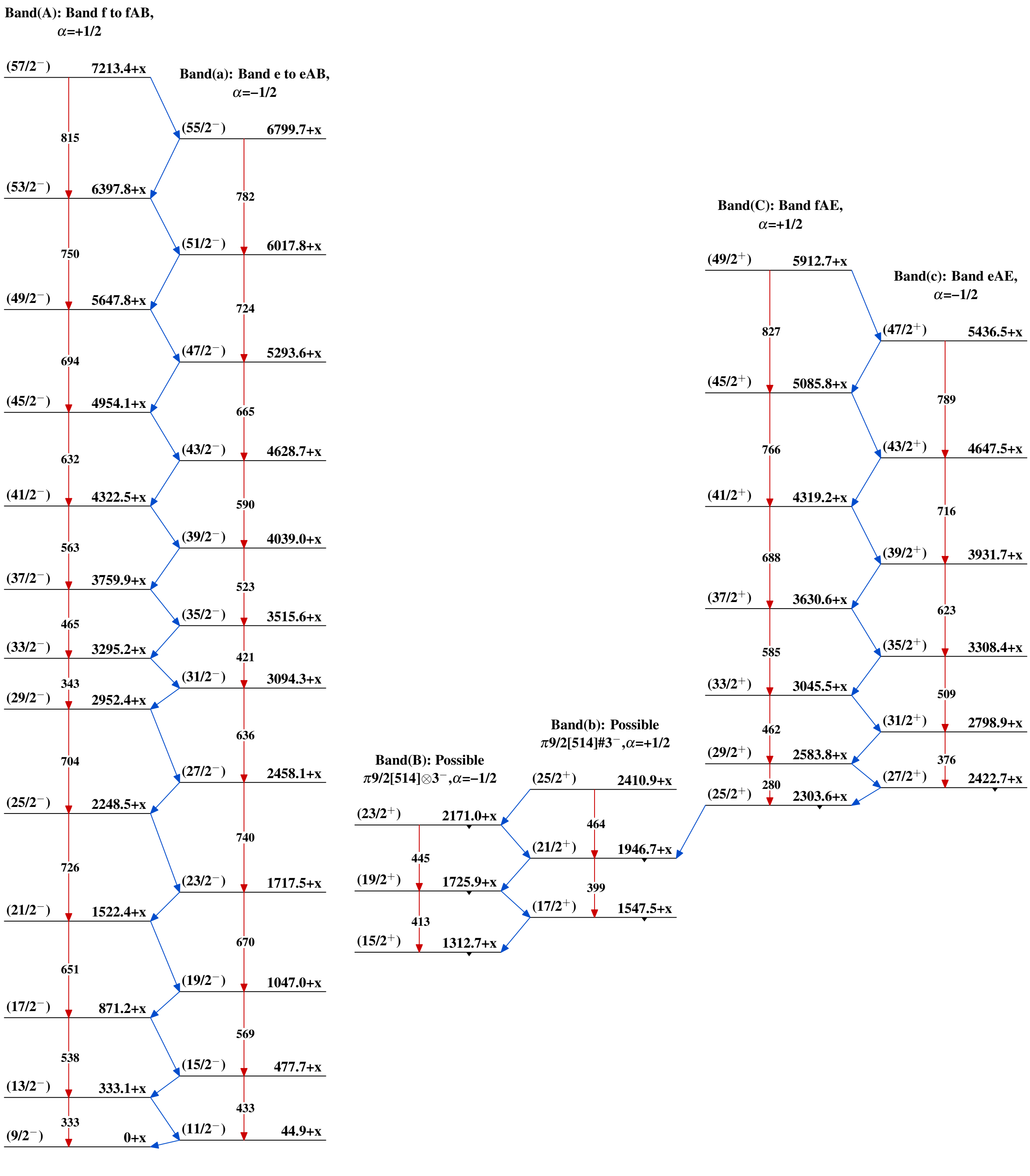

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