^{106}Cd(^{35}Cl,2pnγ) 2001He15,1994Pa14

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Jun Chen	NDS 146, 1 (2017)	30-Sep-2017

2001He15,1994Pa14: E=150 MeV ^{35}Cl beam was produced from the Darebury Laboratory Tandem Van de Graaff accelerator incident on a 500 μg/cm^2 ^{106}Cd target. γ rays were detected with the Eurogam Phase I detector array consisting of 45 large-volume HPGe detectors. Measured Eγ, Iγ, $\gamma\gamma$-coin, γ(DCO), B(M1)/B(E2) ratios. Deduced levels, J, π, configurations, band structures. Comparisons with calculations using the 3-D tilted axis cranking (TAC) model.

^{138}Eu Levels

E(level)†	J$^\pi$‡#	Comments
0+x	(8$^+$)	Additional information 1.
105.02+x& *20*	(9$^+$)	J$^\pi$: from 2001He15 based on systematics of neighbouring N=75 isotones for band-head spin (2001St04, 1998Li36, 1996Li13).
272.0+x@ *3*	(10$^+$)	
545.2+x& *3*	(11$^+$)	
629.5+x*a* *6*	(10$^+$)	
793.5+x*b* *6*	(11$^+$)	
807.4+x@ *4*	(12$^+$)	
1092.6+x*a* *6*	(12$^+$)	
1169.9+x& *4*	(13$^+$)	
1443.5+x*b* *6*	(13$^+$)	
1490.1+x@ *4*	(14$^+$)	
1849.1+x*a* *7*	(14$^+$)	
1917.5+x& *4*	(15$^+$)	
2044.4+x*c* *4*	(13$^-$)	
2232.2+x*b* *7*	(15$^+$)	
2286.2+x*c* *4*	(14$^-$)	
2299.6+x@ *4*	(16$^+$)	
2521.6+x*c* *4*	(15$^-$)	
2710.1+x*a* *10*	(16$^+$)	
2762.3+x& *4*	(17$^+$)	
2780.3+x*c* *4*	(16$^-$)	
3066.9+x*c* *4*	(17$^-$)	
3129.2+x*b* *13*	(17$^+$)	
3178.9+x@ *4*	(18$^+$)	
3347.0+x*d* *4*	(17$^-$)	
3395.4+x*c* *4*	(18$^-$)	
3590.3+x& *4*	(19$^+$)	
3744.1+x*c* *4*	(19$^-$)	
3780.4+x*d* *4*	(18$^-$)	
4016.2+x@ *4*	(20$^+$)	
4141.0+x*c* *4*	(20$^-$)	
4257.6+x*d* *4*	(19$^-$)	
4456.8+x& *4*	(21$^+$)	
4548.0+x*c* *4*	(21$^-$)	
4751.0+x*d* *4*	(20$^-$)	
4983.1+x@ *5*	(22$^+$)	
5010.5+x*c* *5*	(22$^-$)	

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^{106}Cd(^{35}Cl,2pnγ) 2001He15,1994Pa14 (continued)

^{138}Eu Levels (continued)

E(level)[†]	Jπ[‡#]
5481.0+x[c] 5	(23⁻)
5486.8+x[&] 5	(23⁺)
6026.5+x[@] 5	(24⁺)
6632.3+x[&] 5	(25⁺)

† From a least-squares fit to γ-ray energies, assuming ΔEγ=1 keV when unknown.
‡ Based on γ(θ), γ multipolarities, band structures and systematics of neighbouring isotones. The positive parity states follow the assignments from 2001He15, while the J values of the negative parity states are those from 1994Pa14, increased by one unit after private communication of the evaluator of 2003So13 with the author E.S.Paul (2002PaZZ).
# Additional information 2.
@ Band(A): Band 1, $\pi h_{11/2}\otimes\nu h_{11/2}$, α=0 (2001He15).
& Band(a): Band 2, $\pi h_{11/2}\otimes\nu h_{11/2}$, α=1 (2001He15).
a Band(B): Band 3, $\pi h_{11/2}\otimes\nu h_{11/2}$, α=0 (2001He15).
b Band(b): Band 4, $\pi h_{11/2}\otimes\nu h_{11/2}$, α=1 (2001He15).
c Band(C): Band 5, possible negative band (1994Pa14).
d Band(D): Band 6, Possible negative band (1994Pa14).

γ(^{138}Eu)

Eγ	Iγ[@]	Ei(level)	Jiπ	Ef	Jfπ	Mult.[#]	Comments
105.0[‡] 2	>100	105.02+x	(9⁺)	0+x	(8⁺)	M1+E2	R(DCO)=0.86 5 at 134°, 0.56 4 at 158° (1994Pa14).
164[†]		793.5+x	(11⁺)	629.5+x	(10⁺)		
167.0[‡] 2	100	272.0+x	(10⁺)	105.02+x	(9⁺)	M1+E2	R(DCO)=0.67 4 at 134°, 0.53 4 at 158° (1994Pa14).
235.4[‡] 2	4.8	2521.6+x	(15⁻)	2286.2+x	(14⁻)	M1+E2	R(DCO)=0.7 1 at 134°, 0.5 1 at 158° (1994Pa14).
241.5[‡] 2	1.6	2286.2+x	(14⁻)	2044.4+x	(13⁻)		
258.7[‡] 2	7.2	2780.3+x	(16⁻)	2521.6+x	(15⁻)		
262.2[‡] 2	46.5	807.4+x	(12⁺)	545.2+x	(11⁺)	M1+E2	R(DCO)=0.65 5 at 134°, 0.39 4 at 158° (1994Pa14).
273.3[‡] 2	64.7	545.2+x	(11⁺)	272.0+x	(10⁺)	M1+E2	R(DCO)=0.56 4 at 134°, 0.43 4 at 158° (1994Pa14).
286.6[‡] 2	6.9	3066.9+x	(17⁻)	2780.3+x	(16⁻)		
299[†]		1092.6+x	(12⁺)	793.5+x	(11⁺)		
320.4[‡] 2	4.5	1490.1+x	(14⁺)	1169.9+x	(13⁺)	M1+E2	R(DCO)=0.56 5 at 134°, 0.42 3 at 158° (1994Pa14).
328.4[‡] 2	5.4	3395.4+x	(18⁻)	3066.9+x	(17⁻)		
348.5[‡] 2	1.0	3744.1+x	(19⁻)	3395.4+x	(18⁻)		
351[†]		1443.5+x	(13⁺)	1092.6+x	(12⁺)		
362.7[‡] 2	31.7	1169.9+x	(13⁺)	807.4+x	(12⁺)	M1+E2	R(DCO)=0.49 4 at 134°, 0.32 3 at 158° (1994Pa14).
382.4[‡] 2	9.7	2299.6+x	(16⁺)	1917.5+x	(15⁺)	M1+E2	R(DCO)=0.74 5 at 134°, 0.61 5 at 158° (1994Pa14) (1994Pa14).
383[†]		2232.2+x	(15⁺)	1849.1+x	(14⁺)		
396.9[‡] 2	2.8	4141.0+x	(20⁻)	3744.1+x	(19⁻)		
405[†]		1849.1+x	(14⁺)	1443.5+x	(13⁺)		
406.9[‡] 2	1.4	4548.0+x	(21⁻)	4141.0+x	(20⁻)		
411.8[‡] 2	7.5	3590.3+x	(19⁺)	3178.9+x	(18⁺)		
416.7[‡] 2	3.4	3178.9+x	(18⁺)	2762.3+x	(17⁺)		
420[†a]		3129.2+x	(17⁺)	2710.1+x	(16⁺)		

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^{106}Cd(^{35}Cl,2pnγ) 2001He15,1994Pa14 (continued)

γ(^{138}Eu) (continued)

E_γ	I_γ[@]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	Comments
426.0[‡] *2*	6.9	4016.2+x	(20$^+$)	3590.3+x	(19$^+$)	M1+E2	R(DCO)=0.58 *4* at 134°, 0.54 *4* at 158°, values for the 426.0-427.7 doublet (1994Pa14).
427.7[‡] *2*	17.6	1917.5+x	(15$^+$)	1490.1+x	(14$^+$)	M1+E2	R(DCO)=0.58 *4* at 134°, 0.54 *4* at 158°, values for the 426.0-427.7 doublet (1994Pa14).
435.1[‡] *2*	1.6	3780.4+x	(18$^-$)	3347.0+x	(17$^-$)		E_γ: poor-fit; uncertainty was increased to $\Delta E\gamma$=0.6 keV in the fitting procedure. Level-energy difference=433.40.
440.5[&‡]	5.3[&]	545.2+x	(11$^+$)	105.02+x	(9$^+$)	(E2)	R(DCO)=0.9 *1* at 134°, 0.8 *1* at 158°, values for the 440.5 doublet (1994Pa14). Mult.: from the coincidence with the 273.3 M1+E2 γ, it is possible to assign a (E2) value instead of a (M1+E2).
440.5[&‡] *2*	3.0[&]	4456.8+x	(21$^+$)	4016.2+x	(20$^+$)	(M1+E2)	R(DCO)=0.9 *1* at 134°, 0.8 *1* at 158°, values for the 440.5 doublet (1994Pa14).
462.6[‡] *2*	<1	5010.5+x	(22$^-$)	4548.0+x	(21$^-$)		
462.8[‡] *2*	8.0	2762.3+x	(17$^+$)	2299.6+x	(16$^+$)	M1+E2	R(DCO)=0.51 *5* at 134°, 0.55 *5* at 158° (1994Pa14) (1994Pa14).
463[†]		1092.6+x	(12$^+$)	629.5+x	(10$^+$)		
477.4[&‡] *2*	1.0[&]	2521.6+x	(15$^-$)	2044.4+x	(13$^-$)		
477.4[&‡] *2*	2.2[&]	4257.6+x	(19$^-$)	3780.4+x	(18$^-$)		
478[†]		2710.1+x	(16$^+$)	2232.2+x	(15$^+$)		
493.0[‡] *2*	<1	4751.0+x	(20$^-$)	4257.6+x	(19$^-$)		
494.1[‡] *2*	2.0	2780.3+x	(16$^-$)	2286.2+x	(14$^-$)	E2	R(DCO)=1.2 *2* at 134° (1994Pa14).
504.2[‡] *2*	<1	5486.8+x	(23$^+$)	4983.1+x	(22$^+$)		
522[†]		793.5+x	(11$^+$)	272.0+x	(10$^+$)		
524[†]		629.5+x	(10$^+$)	105.02+x	(9$^+$)		
526.4[‡] *2*	<1	4983.1+x	(22$^+$)	4456.8+x	(21$^+$)		
535.3[‡] *2*	20.6	807.4+x	(12$^+$)	272.0+x	(10$^+$)	E2	R(DCO)=1.2 *1* at 134°, 1.3 *2* at 158° (1994Pa14).
545.5[‡] *2*	2.9	3066.9+x	(17$^-$)	2521.6+x	(15$^-$)		
547[†]		1092.6+x	(12$^+$)	545.2+x	(11$^+$)		
614.9[‡] *2*	3.5	3395.4+x	(18$^-$)	2780.3+x	(16$^-$)		
624.7[‡] *2*	17.9	1169.9+x	(13$^+$)	545.2+x	(11$^+$)		
630[†]		629.5+x	(10$^+$)	0+x	(8$^+$)		
650[†]		1443.5+x	(13$^+$)	793.5+x	(11$^+$)		
677.6[‡] *2*	4.5	3744.1+x	(19$^-$)	3066.9+x	(17$^-$)		
680[†]		1849.1+x	(14$^+$)	1169.9+x	(13$^+$)		
682.6[‡] *2*	50.3	1490.1+x	(14$^+$)	807.4+x	(12$^+$)	E2	R(DCO)=1.0 *1* at 134°, 1.1 *1* at 158° (1994Pa14).
688[†]		793.5+x	(11$^+$)	105.02+x	(9$^+$)		
743[†]		2232.2+x	(15$^+$)	1490.1+x	(14$^+$)		
745.4[‡] *2*	5.3	4141.0+x	(20$^-$)	3395.4+x	(18$^-$)		
747.4[‡] *2*	32.6	1917.5+x	(15$^+$)	1169.9+x	(13$^+$)		
756[†]		1849.1+x	(14$^+$)	1092.6+x	(12$^+$)		
788[†]		2232.2+x	(15$^+$)	1443.5+x	(13$^+$)		
804.0[‡] *2*	4.0	4548.0+x	(21$^-$)	3744.1+x	(19$^-$)		
809.1[‡] *2*	50.1	2299.6+x	(16$^+$)	1490.1+x	(14$^+$)	E2	R(DCO)=1.0 *1* at 134°, 1.2 *1* at 158° (1994Pa14).
827.6[‡] *2*	13.0	3590.3+x	(19$^+$)	2762.3+x	(17$^+$)		
837.4[‡] *2*	8.4	4016.2+x	(20$^+$)	3178.9+x	(18$^+$)		

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^{106}Cd(^{35}Cl,2pnγ) 2001He15,1994Pa14 (continued)

γ(^{138}Eu) (continued)

E_γ	I_γ[@]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	Comments
844.9[‡] *2*	28.3	2762.3+x	(17$^+$)	1917.5+x	(15$^+$)	E2	R(DCO)=1.1 *1* at 134°, 1.0 *1* at 158° (1994Pa14).
861[†]		2710.1+x	(16$^+$)	1849.1+x	(14$^+$)		
862.5[‡] *2*	3.3	2780.3+x	(16$^-$)	1917.5+x	(15$^+$)		
866.2[‡] *2*	11.0	4456.8+x	(21$^+$)	3590.3+x	(19$^+$)		
869.5[‡] *2*	1.7	5010.5+x	(22$^-$)	4141.0+x	(20$^-$)		
879.0[‡] *2*	29.5	3178.9+x	(18$^+$)	2299.6+x	(16$^+$)	E2	R(DCO)=1.0 *1* at 134°, 1.0 *1* at 158° (1994Pa14).
897[†]		1443.5+x	(13$^+$)	545.2+x	(11$^+$)		
897[†]		3129.2+x	(17$^+$)	2232.2+x	(15$^+$)		
910.6[‡] *2*	4.4	4257.6+x	(19$^-$)	3347.0+x	(17$^-$)		
933.0[‡] *2*	<1	5481.0+x	(23$^-$)	4548.0+x	(21$^-$)		
967.4[‡] *2*	6.4	4983.1+x	(22$^+$)	4016.2+x	(20$^+$)		
970.9[‡] *2*	5.8	4751.0+x	(20$^-$)	3780.4+x	(18$^-$)		
1018.4[‡] *2*	14.4	3780.4+x	(18$^-$)	2762.3+x	(17$^+$)	(E1)	R(DCO)=1.0 *1* at 134°, dipole-gated (1994Pa14).
1029.4[‡] *2*	14.7	5486.8+x	(23$^+$)	4456.8+x	(21$^+$)		
1031.6[‡] *2*	4.5	2521.6+x	(15$^-$)	1490.1+x	(14$^+$)	(E1)	R(DCO)=0.9 *1* at 134°, dipole-gated (1994Pa14).
1043.4[‡] *2*	6.2	6026.5+x	(24$^+$)	4983.1+x	(22$^+$)		
1047.6[‡] *2*	13.7	3347.0+x	(17$^-$)	2299.6+x	(16$^+$)		
1060[†a]		2232.2+x	(15$^+$)	1169.9+x	(13$^+$)		
1078.3[‡] *2*	10.2	4257.6+x	(19$^-$)	3178.9+x	(18$^+$)	(E1)	R(DCO)=0.6 *2* at 134°, 0.4 *2* at 158° (1994Pa14).
1116.5[‡] *2*	7.3	2286.2+x	(14$^-$)	1169.9+x	(13$^+$)	(E1)	R(DCO)=1.1 *2* at 134°, dipole-gated (1994Pa14).
1145.5[‡] *2*	5.2	6632.3+x	(25$^+$)	5486.8+x	(23$^+$)		
1237.0[‡] *2*	6.5	2044.4+x	(13$^-$)	807.4+x	(12$^+$)		

[†] From 2001He15.
[‡] From 1994Pa14.
[#] From 1994Pa14 based on measured γ(DCO), assuming E2 for Mult=Q. DCO ratios were obtained as R(DCO)=Iγ(134°,90°)/Iγ(90°,134°) at 134° or Iγ(158°,90°)/Iγ(90°,158°) at 158°, by gating on E2 transitions. Expected values are ≥1.0 for a stretched quadrupole transition and 0.6-0.7 for a pure stretched dipole transition (1994Pa14).
[@] From 1994Pa14, relative to Iγ(167.0γ)=100. Errors are estimated to typically ≤5% (1994Pa14).
[&] Multiply placed with intensity suitably divided.
[a] Placement of transition in the level scheme is uncertain.

$^{106}Cd(^{35}Cl,2pn\gamma)$ 2001He15,1994Pa14

Level Scheme

Intensities: Relative I_γ

@ Multiply placed: intensity suitably divided

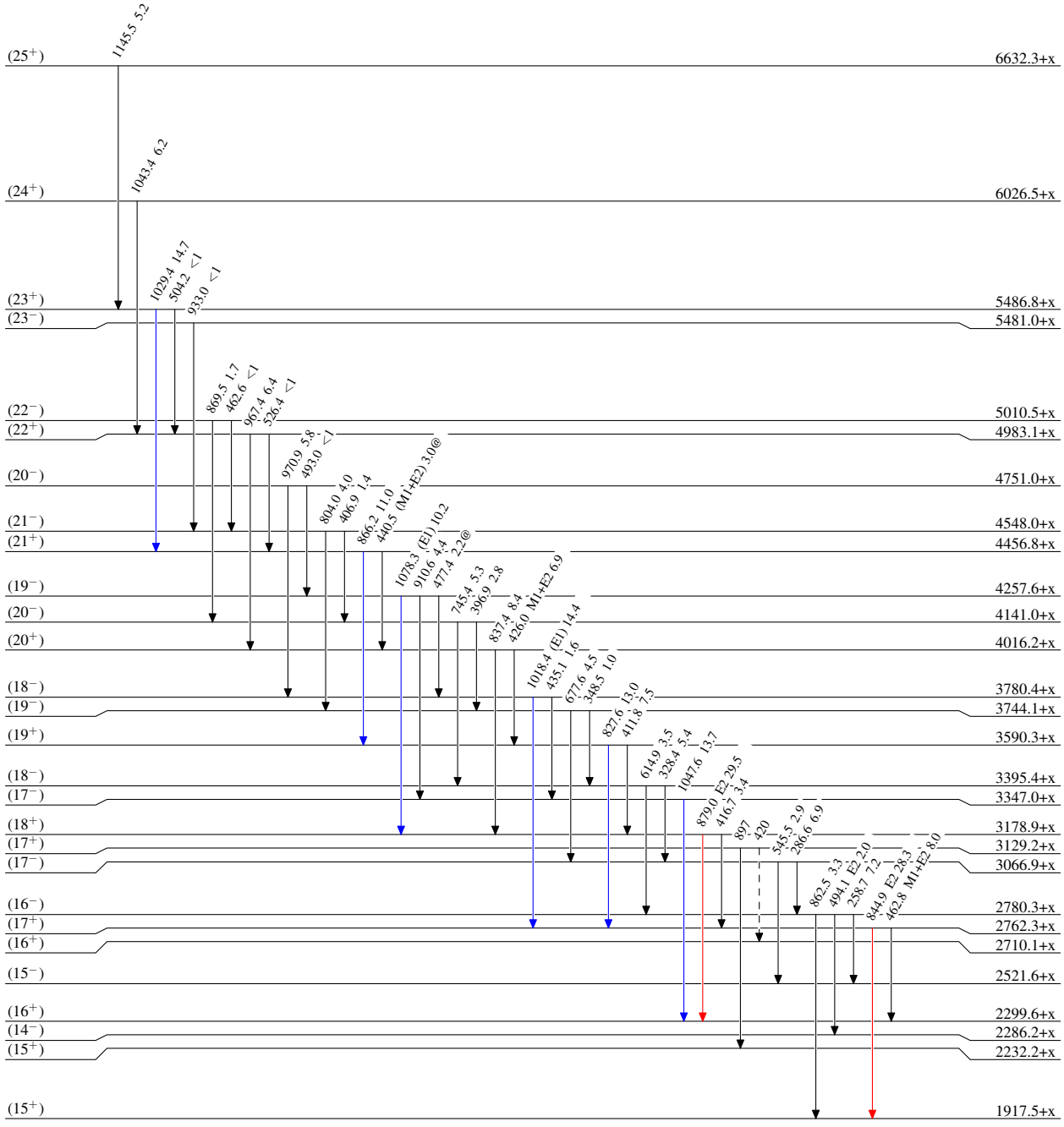
Legend

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

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

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

γ Decay (Uncertain)



$^{138}_{63}Eu_{75}$

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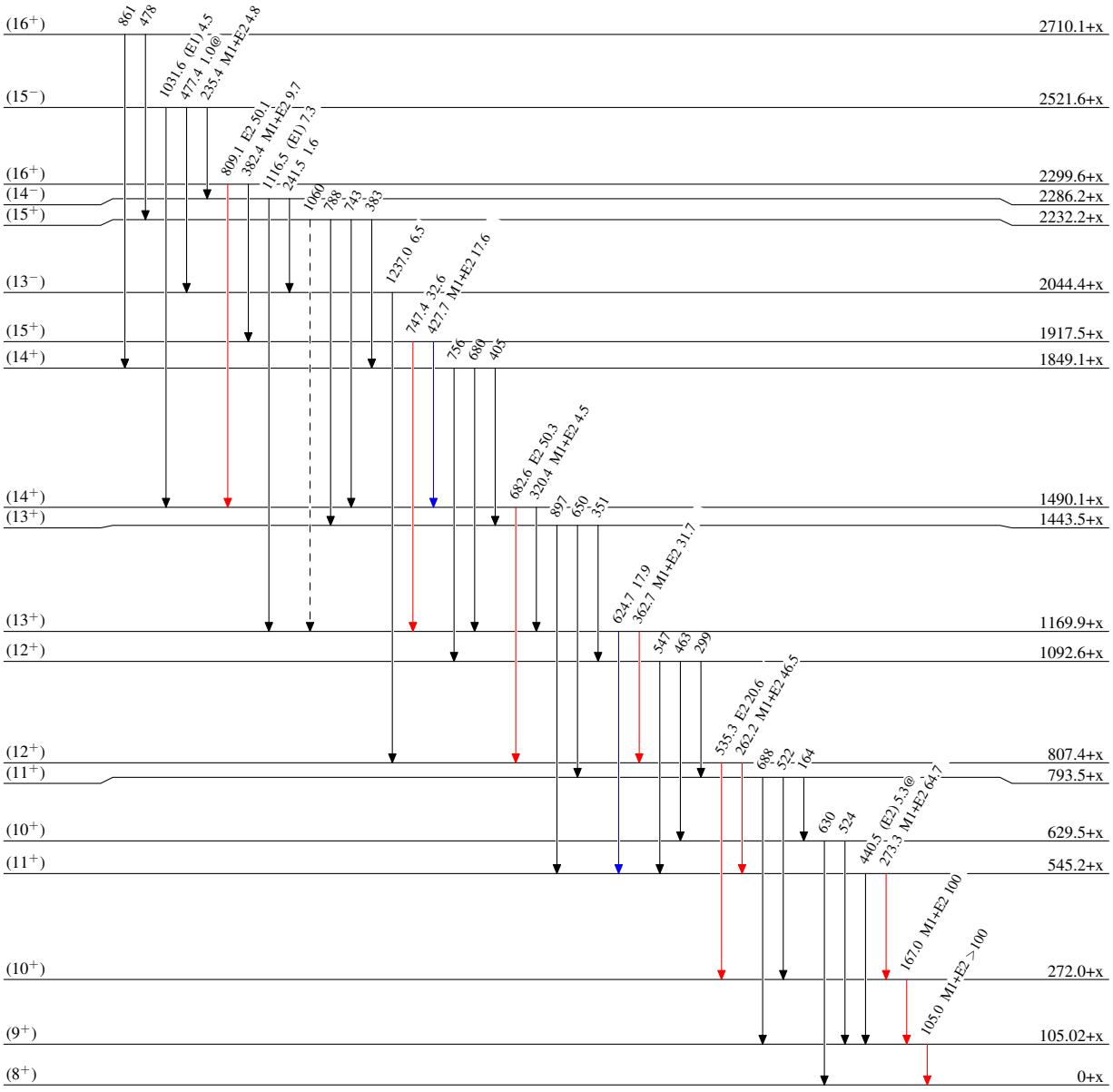
Level Scheme (continued)

Intensities: Relative I_γ
@ Multiply placed: intensity suitably divided

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)



$^{138}_{63}Eu_{75}$

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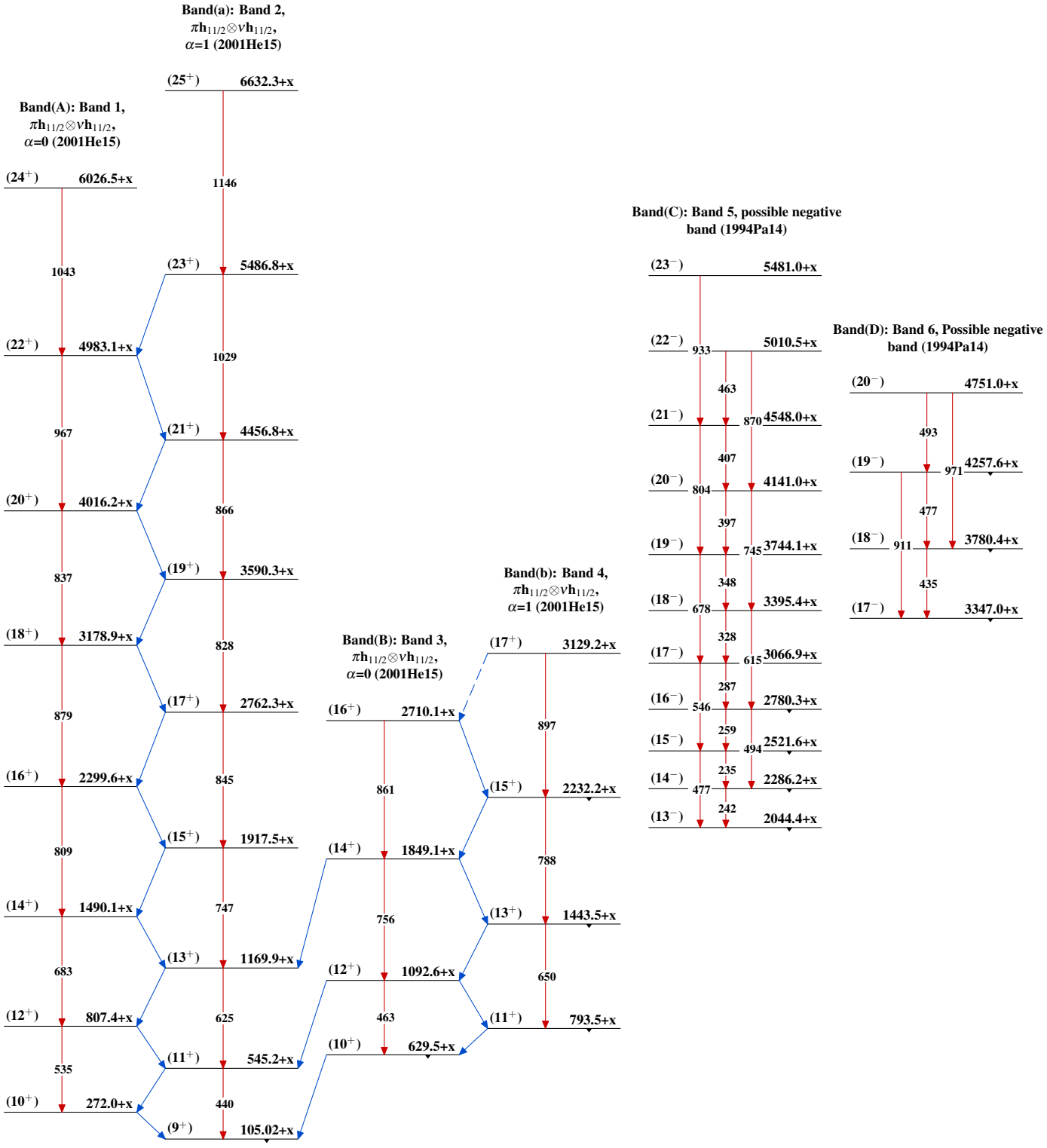

$^{138}_{63}Eu_{75}$