^{116}Cd(^{27}Al,4nγ):iuac 2009Dh01

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	P. K. Joshi, B. Singh, S. Singh, A. K. Jain	NDS 138, 1 (2016)	15-Oct-2016

2009Dh01: E=120 MeV; measured Eγ, Iγ, $\gamma\gamma$-coin, $\gamma\gamma(\theta)$(DCO) using Gamma Detector Array consisting of twelve 23% Compton-suppressed n-type HPGe detectors and a multiplicity filter consisting of 14 hexagonal BGO detectors at IUAC, New Delhi. Comparison with tilted axis cranking calculations.

^{139}Pm Levels

E(level)[†]	J$^{\pi}$[#]	$T_{1/2}$	Comments
0.0[‡]	(5/2$^+$)[‡]		
188.7[‡c] *3*	11/2$^-$[‡]	180 ms *20*	%IT=100; %ε+%β^+<0.05 $T_{1/2}$ and decay mode from Adopted Levels.
654.6[c] *4*	15/2$^-$		
779.3[d] *4*	13/2$^-$		
1376.2[d] *4*	17/2$^-$		
1405.9[c] *4*	19/2$^-$		
1714.4[&] *4*	15/2$^{(+)}$		
1895.9 *11*			
1952.3[&] *4*	17/2$^{(+)}$		
2107.5[b] *4*	19/2$^+$		
2164.1[&] *4*	19/2$^{(+)}$		
2190.9[d] *4*	21/2$^-$		
2242.0 *4*			
2302.6[&] *4*	21/2$^{(+)}$		
2352.4[c] *4*	23/2$^-$		
2518.4 *4*	21/2$^+$		
2571.1[&] *4*	23/2$^{(+)}$		
2691.2[b] *4*	23/2$^+$		
2768.7 *5*			
2799.0[&] *4*	25/2$^{(+)}$		
2964.7[a] *4*	25/2$^+$		
3119.1[&] *4*	27/2$^{(+)}$		
3158.1[d] *4*	25/2$^-$		
3262.0[g] *4*	27/2$^-$		
3281.3[b] *4*	27/2$^+$		
3307.5 *11*			
3367.5 *5*			
3393.5[&] *4*	29/2$^{(+)}$		
3402.6 *5*			
3416.9[c] *4*	27/2$^-$		
3416.9+x[f]			Additional information 1.
3491.8 *4*			
3526.0[e] *11*			
3558.6[a] *4*	29/2$^+$		
3591.5[g] *4*	29/2$^-$		
3679.4 *5*			
3763.0[&] *5*	31/2$^{(+)}$		
3863.3 *5*			
3908.0[g] *4*	31/2$^-$		
3986.9 *11*			

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^{116}Cd(^{27}Al,4nγ):iuac 2009Dh01 (continued)

^{139}Pm Levels (continued)

E(level)†	Jπ#	E(level)†	Jπ#	E(level)†	Jπ#	E(level)†	Jπ#
4056.4[b] 4	31/2+	4834.4[g] 4	35/2−	5505.6[a] 5	37/2+	6561.8[h] 5	45/2(−)
4082.3 4		4878.24+x[f] 23		5516.0 5		6704.6[a] 5	(41/2+)
4085.94+x[f] 10		4922.9 4		5681.6[h] 4	39/2(−)	6722.9[c] 4	43/2−
4089.5 5		4932.0[b] 4	35/2+	5727.7[e] 5		6724.9[e] 5	
4123.2[&] 5	33/2(+)	4956.6[&] 6	37/2(+)	5843.7[g] 4	(37/2−)	6875.2[h] 5	47/2(−)
4336.0 4		5038.7 5		5874.8[b] 5	(39/2+)	6939.1[b] 6	(43/2+)
4380.7[g] 4	33/2−	5105.4[e] 5		5943.5[h] 4	41/2(−)	7504.2[c] 4	47/2−
4383.8[c] 4	31/2−	5162.0 11		5971.8 4		7918.6[a] 11	(45/2+)
4409.0[e] 4		5248.8 5		6060.1[c] 4	39/2−	8447.0[c] 5	51/2−
4417.9[a] 4	33/2+	5259.4[c] 4	35/2−	6109.2 5		9179.1[@] 5	
4467.4 5		5283.9 5		6167.6[h] 5	43/2(−)	9363.4[@] 6	
4486.6 5		5306.7 5		6340.8+x[f] 5		9482.8[c] 5	55/2−
4555.9[&] 5	35/2(+)	5441.9+x[f] 3		6376.6[g] 5	(39/2−)		

† From least-squares fit to Eγ data. Reduced χ^2=2.9 as compared to critical χ^2=2.0.
‡ From Adopted Levels, as also the decay modes for the 180-ms isomer.
# As proposed in 2009Dh01 based on yrast population of levels, γγ(θ)(DCO) measurements, and band associations.
@ Level connected with yrast band based on 11/2− isomer.
& Band(A): 3-qp,ΔJ=1 band based on 15/2(+). Possible Configuration=$\pi h_{11/2}\otimes\nu s_{1/2}\otimes\nu h_{11/2}$ or $\pi h_{11/2}\otimes\nu d_{3/2}\otimes\nu h_{11/2}$.
a Band(B): 3-qp ΔJ=2 band based on 25/2+. Possible configuration=$\pi g_{7/2}\otimes\pi h^2_{11/2}$ or $\pi d_{5/2}\otimes\pi h^2_{11/2}$.
b Band(C): 3-qp ΔJ=2 band based on 19/2+. Possible configuration=$\pi g_{7/2}\otimes\pi h^2_{11/2}$ or $\pi d_{5/2}\otimes\pi h^2_{11/2}$.
c Band(D): Yrast band based on 11/2− isomer.
d Band(E): Band based on 13/2−.
e Band(F): γ cascade-1.
f Band(G): γ cascade-2.
g Band(H): Magnetic-dipole rotational band-1. Probable configuration=$\pi h_{11/2}\otimes\nu h^{-2}_{11/2}$.
h Band(I): Magnetic-dipole rotational band-2. Probable configuration=$\pi h^3_{11/2}\otimes\nu h^{-2}_{11/2}$.

γ(^{139}Pm)

DCO ratios are for 153°−99° geometry and gates are on ΔJ=2, quadrupole transitions, unless otherwise indicated.

Eγ	Iγ	Ei(level)	Jiπ	Ef	Jfπ	Mult.†	Comments
103.8 1	3.1 4	3262.0	27/2−	3158.1	25/2−	D	DCO=0.9 3 DCO for ΔJ=1, dipole gate.
138.5 1	8.9 2	2302.6	21/2(+)	2164.1	19/2(+)	D	DCO=0.55 10
188.7 3		188.7	11/2−	0.0	(5/2+)	E3	Eγ,Mult.: from Adopted Gammas.
211.8 1	13.2 6	2164.1	19/2(+)	1952.3	17/2(+)	D	DCO=0.61 11
224.1 1	4.2 3	6167.6	43/2(−)	5943.5	41/2(−)	D	DCO=1.25 21 DCO for ΔJ=1, dipole gate.
227.8 1	4.9 3	2799.0	25/2(+)	2571.1	23/2(+)	(D)	DCO=0.7 3
237.8 1	1.9 3	1952.3	17/2(+)	1714.4	15/2(+)	(D)	DCO=0.7 4
261.9 1	4.7 6	5943.5	41/2(−)	5681.6	39/2(−)	D	DCO=1.2 3 DCO for ΔJ=1, dipole gate.
268.4 1	14.1 9	2571.1	23/2(+)	2302.6	21/2(+)	D	DCO=0.62 9

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^{116}Cd(^{27}Al,4nγ):iuac 2009Dh01 (continued)

$\gamma(^{139}Pm)$ (continued)

E_γ	I_γ	E_i(level)	J_i^π	E_f	J_f^π	Mult.[†]	Comments
274.4 *1*	3.7 *4*	3393.5	$29/2^{(+)}$	3119.1	$27/2^{(+)}$	D	DCO=0.45 *25*
313.4 *1*	1.4 *2*	6875.2	$47/2^{(-)}$	6561.8	$45/2^{(-)}$	(D)	DCO=0.6 *3*
316.5 *1*	12.7 *8*	3908.0	$31/2^-$	3591.5	$29/2^-$	D	DCO=1.10 *9* DCO for ΔJ=1, dipole gate.
320.1 *1*	4.8 *3*	3119.1	$27/2^{(+)}$	2799.0	$25/2^{(+)}$	(D)	DCO=0.6 *3*
329.4 *1*	18.5 *9*	3591.5	$29/2^-$	3262.0	$27/2^-$	D	DCO=0.45 *5*
338.5 *2*	1.9 *7*	2691.2	$23/2^+$	2352.4	$23/2^-$		
360.2 *2*	2.9 *5*	4123.2	$33/2^{(+)}$	3763.0	$31/2^{(+)}$	D	DCO=0.4 *3*
369.4 *2*	3.5 *6*	3763.0	$31/2^{(+)}$	3393.5	$29/2^{(+)}$	(D)	DCO=0.5 *4*
388.7 *1*	2.4 *3*	2691.2	$23/2^+$	2302.6	$21/2^{(+)}$		
393.7 *1*	5.3 *4*	2964.7	$25/2^+$	2571.1	$23/2^{(+)}$	(D)	DCO=0.7 *3*
394.2 *1*	1.6 *3*	6561.8	$45/2^{(-)}$	6167.6	$43/2^{(-)}$	D	DCO=0.67 *21*
400.7 *2*	1.0 *6*	4956.6	$37/2^{(+)}$	4555.9	$35/2^{(+)}$	(D)	DCO=0.7 *4*
402.8 *3*	0.9 *5*	3367.5		2964.7	$25/2^+$		
432.7 *2*	2.5 *9*	4555.9	$35/2^{(+)}$	4123.2	$33/2^{(+)}$	D	DCO=0.5 *3*
446.2 *1*	1.7 *6*	2964.7	$25/2^+$	2518.4	$21/2^+$	(Q)	DCO=1.0 *6*
453.7 *1*	4.8 *6*	4834.4	$35/2^-$	4380.7	$33/2^-$	D	DCO=1.1 *3* DCO for ΔJ=1, dipole gate.
465.9 *1*	100	654.6	$15/2^-$	188.7	$11/2^-$	Q	DCO=0.96 *6*
472.7 *1*	8.3 *3*	4380.7	$33/2^-$	3908.0	$31/2^-$	D	DCO=0.85 *12* DCO for ΔJ=1, dipole gate.
490.0	<1.0	1895.9		1405.9	$19/2^-$		
497.1 *2*	2.8 *5*	2799.0	$25/2^{(+)}$	2302.6	$21/2^{(+)}$		E_γ: poor fit, level energy difference=496.4.
526.7 *2*	3.2 *8*	2768.7		2242.0			
532.9 *2*	2.9 *7*	6376.6	$(39/2^-)$	5843.7	$(37/2^-)$	(D)	DCO=0.8 *5*
563.7 *2*	2.7 *5*	5441.9+x		4878.24+x			
570.0	<1.0	3986.9		3416.9	$27/2^-$		
583.7 *1*	7.3 *4*	2691.2	$23/2^+$	2107.5	$19/2^+$	(Q)	DCO=1.1 *4*
590.1 *1*	8.0 *3*	3281.3	$27/2^+$	2691.2	$23/2^+$	Q	DCO=1.1 *3*
590.5[‡] *2*	1.6[‡] *3*	779.3	$13/2^-$	188.7	$11/2^-$		
590.5[‡] *2*	1.6[‡] *3*	4082.3		3491.8			
593.9 *1*	11.4 *4*	3558.6	$29/2^+$	2964.7	$25/2^+$	Q	DCO=1.17 *12*
596.8 *2*	1.4 *3*	1376.2	$17/2^-$	779.3	$13/2^-$		
601.3 *3*	2.2 *9*	3863.3		3262.0	$27/2^-$		
612.2 *1*	8.6 *8*	2964.7	$25/2^+$	2352.4	$23/2^-$	D	DCO=0.6 *3* DCO for ΔJ=1, dipole gate.
622.3 *2*	2.0 *4*	5727.7		5105.4			
633.9 *1*	2.5 *6*	3402.6		2768.7			
646.2 *2*	1.9 *5*	3908.0	$31/2^-$	3262.0	$27/2^-$		
658.0 *3*	0.9 *4*	5038.7		4380.7	$33/2^-$		
662.8 *1*	7.1 *5*	6722.9	$43/2^-$	6060.1	$39/2^-$	(Q)	DCO=0.8 *3*
669.0 *1*	4.4 *6*	4085.94+x		3416.9+x		(Q)	DCO=0.9 *5*
672.6 *3*	1.9 *8*	4089.5		3416.9	$27/2^-$		
687.9[@] *2*	0.8 *1*	5971.8		5283.9			
692.7 *1*	3.4 *4*	3491.8		2799.0	$25/2^{(+)}$		
696.4 *1*	2.7 *5*	5105.4		4409.0			
701.6 *1*	7.4 *6*	2107.5	$19/2^+$	1405.9	$19/2^-$	(D)	DCO=0.9 *4*
721.7 *1*	13.8 *9*	1376.2	$17/2^-$	654.6	$15/2^-$	D	DCO=0.45 *12*
732.1 *1*	2.2 *1*	9179.1		8447.0	$51/2^-$	(Q)	DCO=0.8 *5*
744.5 *1*	2.3 *4*	4336.0		3591.5	$29/2^-$		
751.3 *1*	65.4 *8*	1405.9	$19/2^-$	654.6	$15/2^-$	Q	DCO=1.02 *6*
775.1 *1*	3.6 *5*	4056.4	$31/2^+$	3281.3	$27/2^+$		
781.3 *1*	7.8 *6*	7504.2	$47/2^-$	6722.9	$43/2^-$	(Q)	DCO=0.9 *4*
784.7 *1*	7.4 *5*	2190.9	$21/2^-$	1405.9	$19/2^-$	D	DCO=0.68 *24*

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^{116}Cd(^{27}Al,4nγ):iuac 2009Dh01 (continued)

γ(^{139}Pm) (continued)

E_γ	I_γ	E_i(level)	J_i^π	E_f	J_f^π	Mult.[†]	Comments
789.0	<1.0	4380.7	33/2$^-$	3591.5	29/2$^-$		
792.3 *2*	3.0 *7*	4878.24+x		4085.94+x			
800.7 *1*	11.5 *8*	6060.1	39/2$^-$	5259.4	35/2$^-$	Q	DCO=1.2 *4*
805.8 *2*	1.8 *6*	3158.1	25/2$^-$	2352.4	23/2$^-$		
814.8 *1*	7.0 *9*	2190.9	21/2$^-$	1376.2	17/2$^-$	(Q)	DCO=0.9 *3*
830.9 *3*	0.6 *3*	5248.8		4417.9	33/2$^+$		
847.2 *1*	3.7 *5*	5681.6	39/2$^{(-)}$	4834.4	35/2$^-$	Q	DCO=1.1 *4*
850.4 *2*	1.7 *4*	4409.0		3558.6	29/2$^+$		
859.3 *1*	7.3 *3*	4417.9	33/2$^+$	3558.6	29/2$^+$	Q	DCO=1.30 *24*
865.8 *2*	3.8 *8*	2242.0		1376.2	17/2$^-$		
875.6 *1*	2.4 *2*	4932.0	35/2$^+$	4056.4	31/2$^+$		
875.6 *1*	8.7 *4*	5259.4	35/2$^-$	4383.8	31/2$^-$	(Q)	DCO=1.0 *4*
883.0	<1.0	4409.0		3526.0			
896.9 *1*	5.6 *9*	2302.6	21/2$^{(+)}$	1405.9	19/2$^-$		
898.9 *3*	0.9 *6*	6340.8+x		5441.9+x			
903.2 *2*	1.4 *6*	5283.9		4380.7	33/2$^-$		
909.8 *1*	16.7 *9*	3262.0	27/2$^-$	2352.4	23/2$^-$	Q	DCO=1.04 *14*
916.4 *3*	1.6 *8*	9363.4		8447.0	51/2$^-$		
922.9 *3*	2.2 *8*	5306.7		4383.8	31/2$^-$		
928.0 *3*	1.9 *7*	4486.6		3558.6	29/2$^+$		
942.8[#] *2*	1.7[#] *4*	5874.8	(39/2$^+$)	4932.0	35/2$^+$		
942.8[#] *2*	6.7[#] *3*	8447.0	51/2$^-$	7504.2	47/2$^-$	Q	DCO=0.90 *14*
946.5 *1*	45.9 *7*	2352.4	23/2$^-$	1405.9	19/2$^-$	Q	DCO=1.07 *5*
955.1	<1.0	3307.5		2352.4	23/2$^-$		
966.8 *1*	11.3 *7*	4383.8	31/2$^-$	3416.9	27/2$^-$	Q	DCO=1.1 *4*
967.0 *1*	4.3 *3*	3158.1	25/2$^-$	2190.9	21/2$^-$	Q	DCO=1.8 *4* DCO for ΔJ=1, dipole gate.
981.0	<1.0	4383.8	31/2$^-$	3402.6			
997.2 *2*	1.0 *4*	6724.9		5727.7			
1009.3 *1*	3.9 *5*	5843.7	(37/2$^-$)	4834.4	35/2$^-$	(D)	DCO=0.7 *3*
1014.9 *1*	4.2 *5*	4922.9		3908.0	31/2$^-$	(Q)	DCO=1.0 *5*
1035.8 *2*	1.5 *6*	9482.8	55/2$^-$	8447.0	51/2$^-$		
1050.5 *3*	1.8 *8*	4467.4		3416.9	27/2$^-$		
1059.7 *2*	2.9 *5*	1714.4	15/2$^{(+)}$	654.6	15/2$^-$		
1064.2 *3*	0.8 *3*	6939.1	(43/2$^+$)	5874.8	(39/2$^+$)		
1064.5 *1*	12.6 *9*	3416.9	27/2$^-$	2352.4	23/2$^-$	Q	DCO=1.12 *11*
1087.7 *2*	2.8 *4*	5505.6	37/2$^+$	4417.9	33/2$^+$		
1112.3 *2*	2.5 *4*	2518.4	21/2$^+$	1405.9	19/2$^-$		
1122.0 *3*	3.6 *10*	4383.8	31/2$^-$	3262.0	27/2$^-$		
1199.0 *2*	1.0 *6*	6704.6	(41/2$^+$)	5505.6	37/2$^+$		
1214.0	<1.0	7918.6	(45/2$^+$)	6704.6	(41/2$^+$)		
1254.0	<1.0	5162.0		3908.0	31/2$^-$		
1274.8 *3*	1.1 *5*	6109.2		4834.4	35/2$^-$		
1297.7 *1*	14.5 *5*	1952.3	17/2$^{(+)}$	654.6	15/2$^-$	D	DCO=0.58 *10*
1327.0 *3*	0.8 *3*	3679.4		2352.4	23/2$^-$		
1608.0 *3*	2.5 *9*	5516.0		3908.0	31/2$^-$		

[†] From DCO ratios. Several multipolarities are assigned in 2009Dh01 without DCO ratios and many others are based on DCO ratios with large uncertainties so that it is difficult to distinguish between ΔJ=2, quadrupole and ΔJ=1, dipole transitions.
[‡] Multiply placed with undivided intensity.
[#] Multiply placed with intensity suitably divided.
[@] Placement of transition in the level scheme is uncertain.

^{116}Cd(^{27}Al,4nγ):iuac 2009Dh01

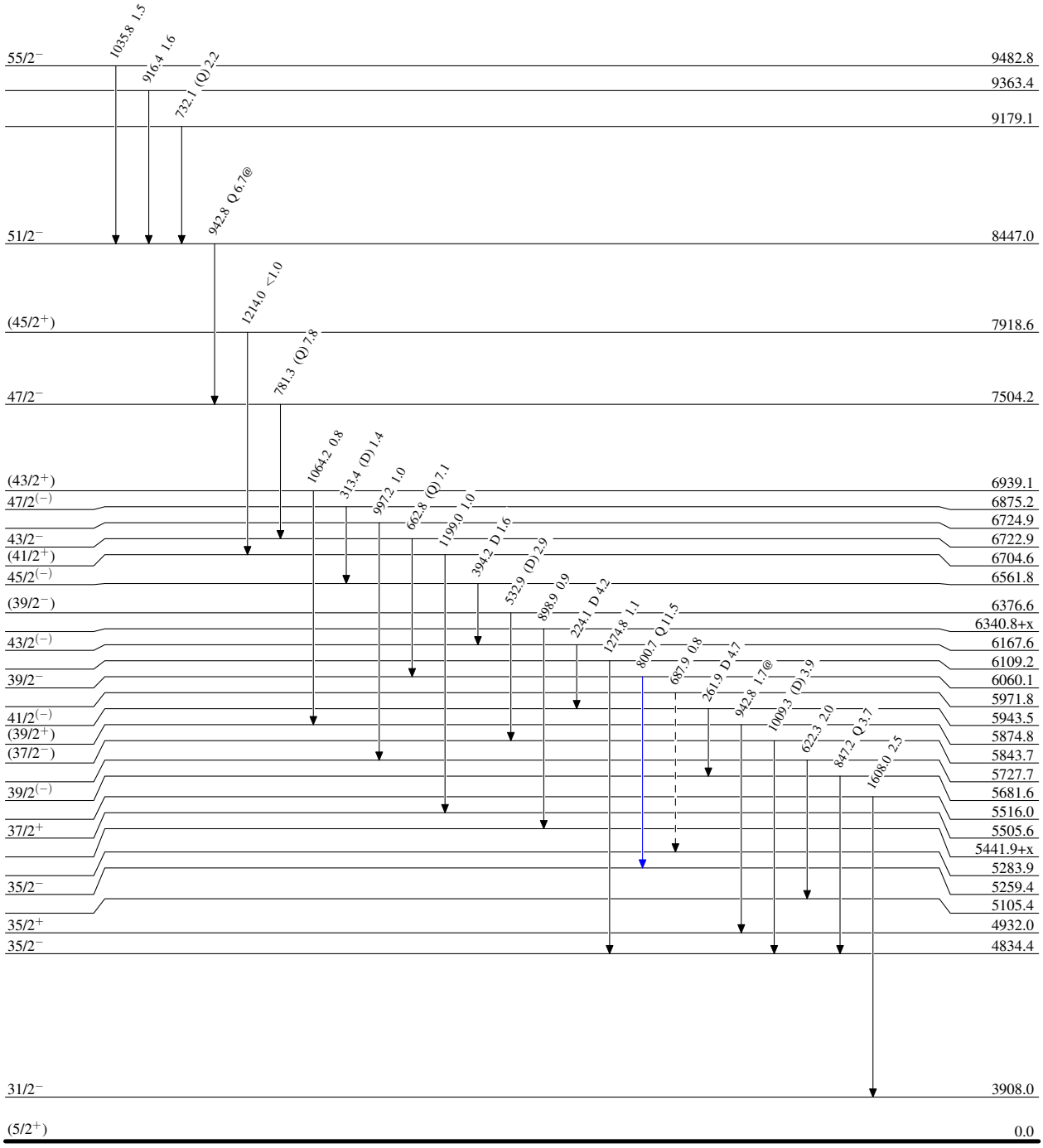
Level Scheme

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)



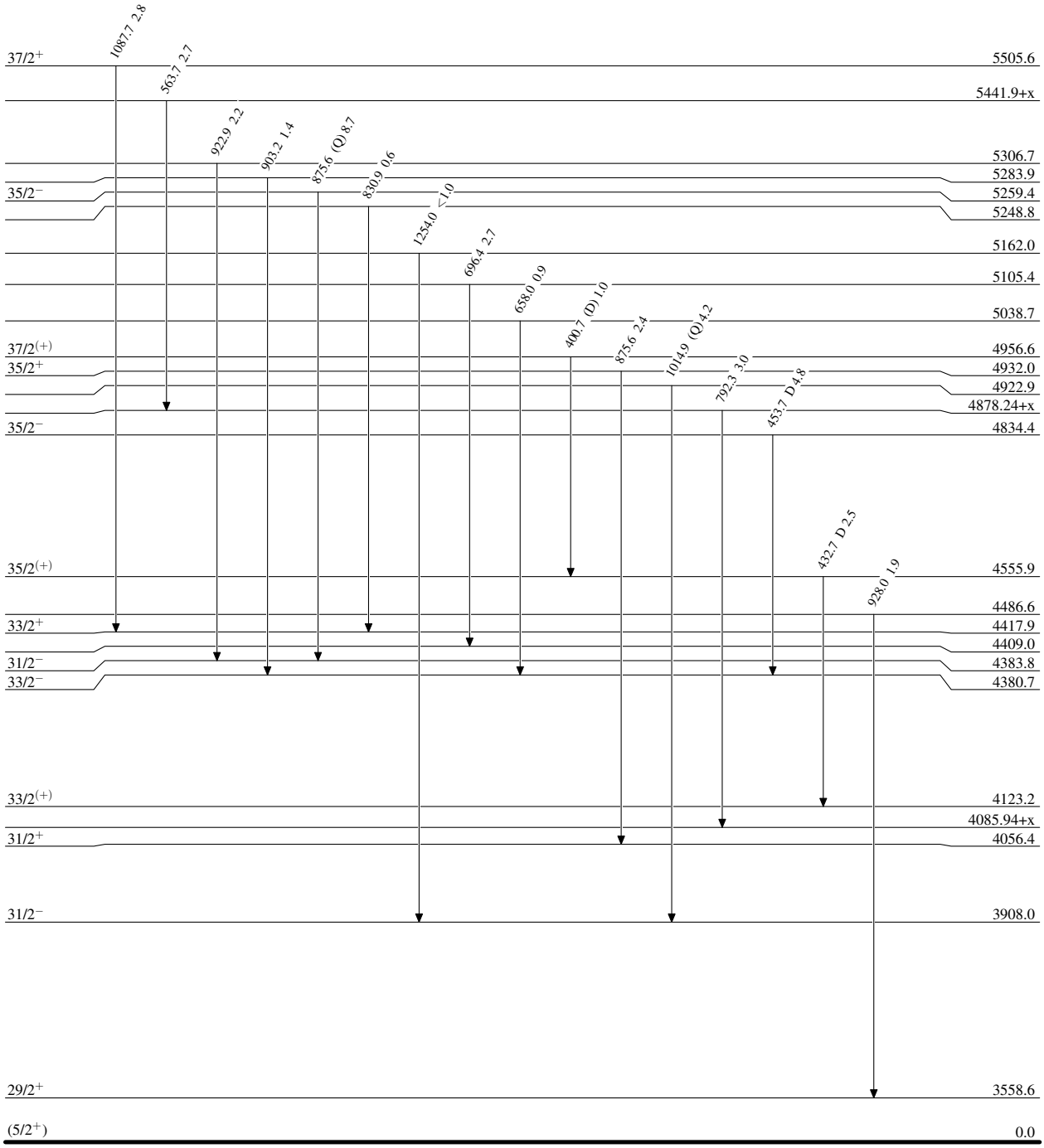
$^{139}_{61}Pm_{78}$

^{116}Cd(^{27}Al,4nγ):iuac 2009Dh01

Level Scheme (continued)

Intensities: Relative I_γ
@ Multiply placed: intensity suitably divided

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



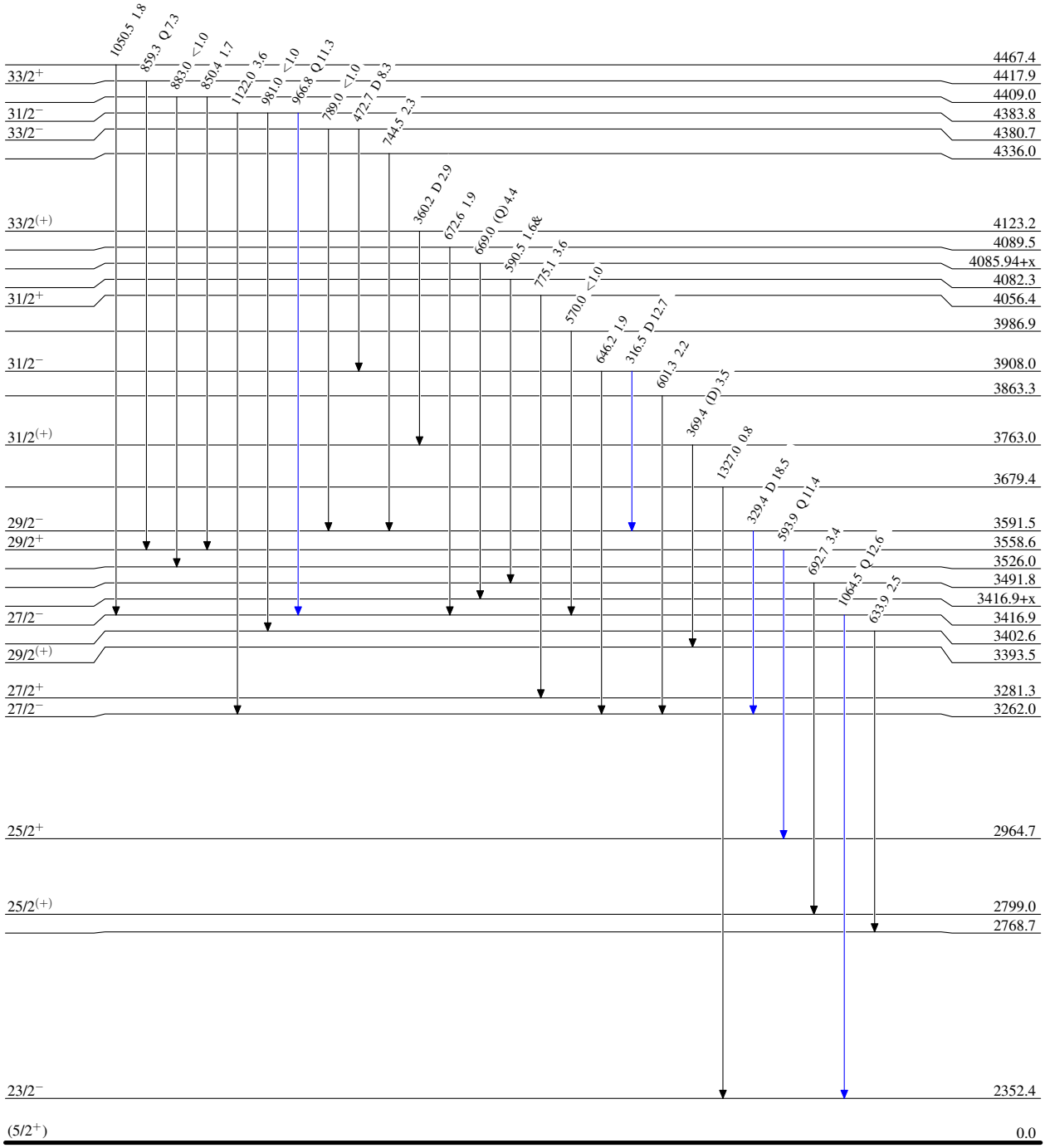
$^{139}_{61}Pm_{78}$

^{116}Cd(^{27}Al,4nγ):iuac 2009Dh01

Level Scheme (continued)

Intensities: Relative I_γ
& Multiply placed: undivided intensity given
@ Multiply placed: intensity suitably divided

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



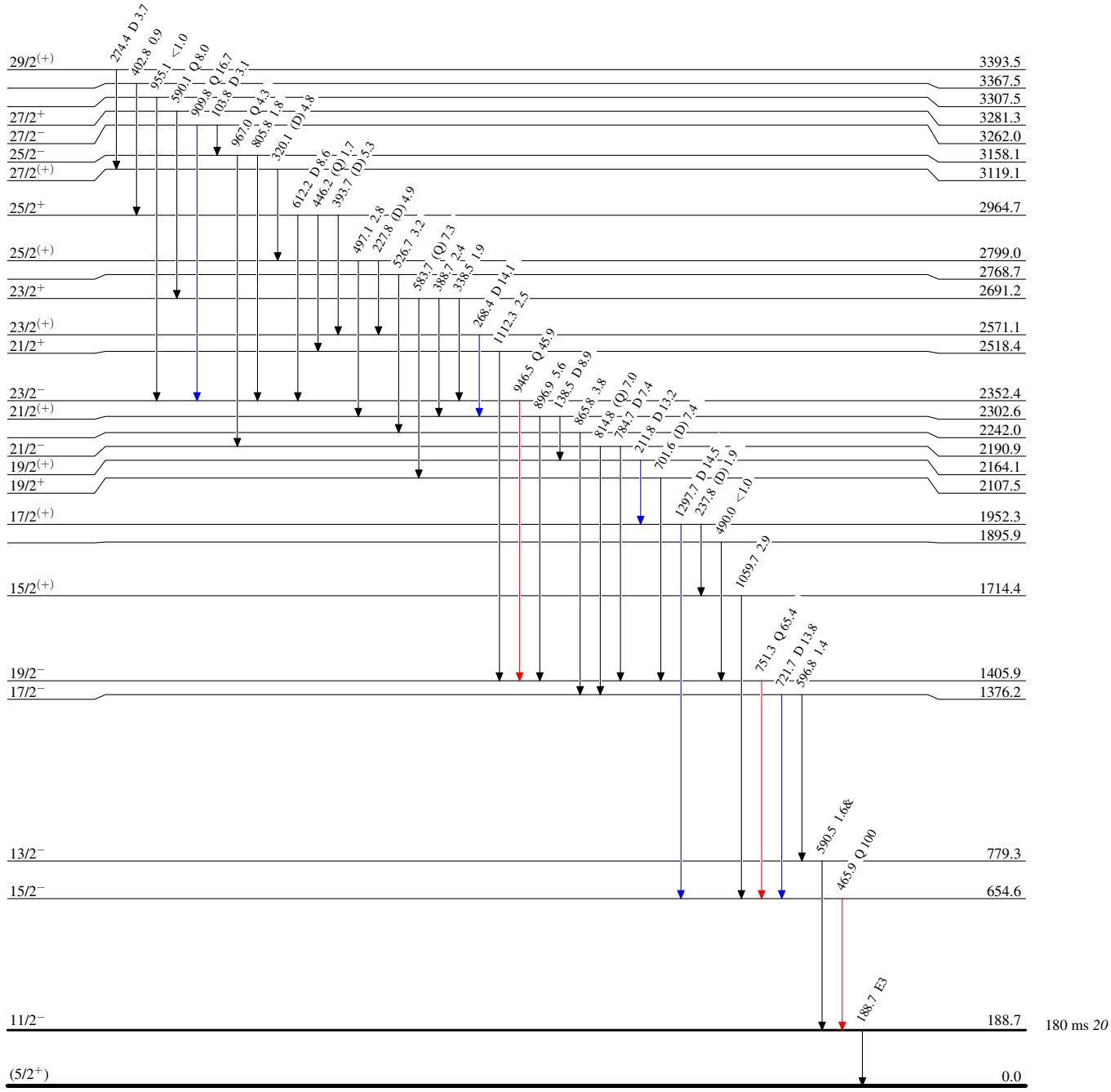
$^{139}_{61}Pm_{78}$

^{116}Cd(^{27}Al,4nγ):iuac 2009Dh01

Level Scheme (continued)

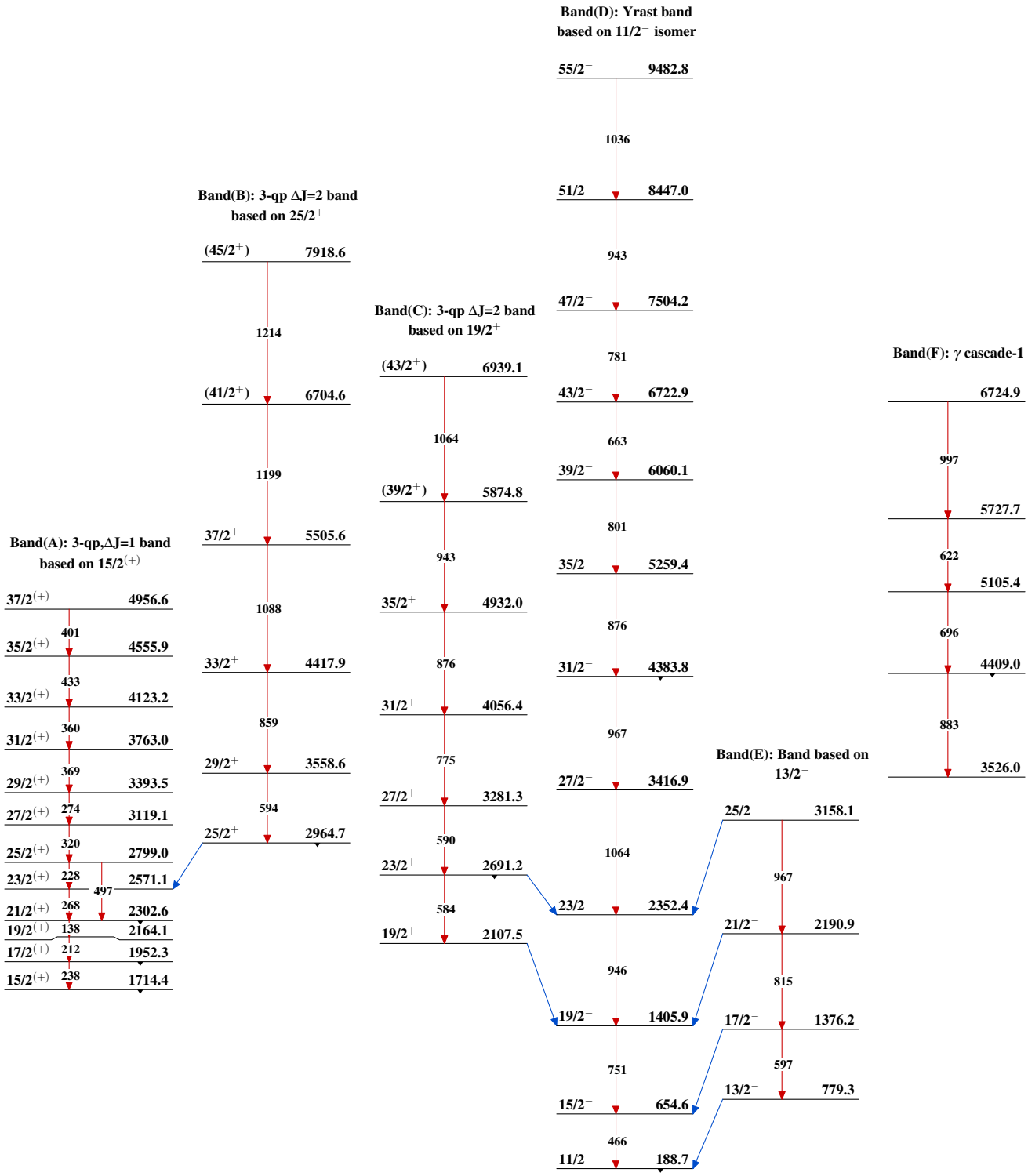
Intensities: Relative I_γ
& Multiply placed: undivided intensity given
@ Multiply placed: intensity suitably divided

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



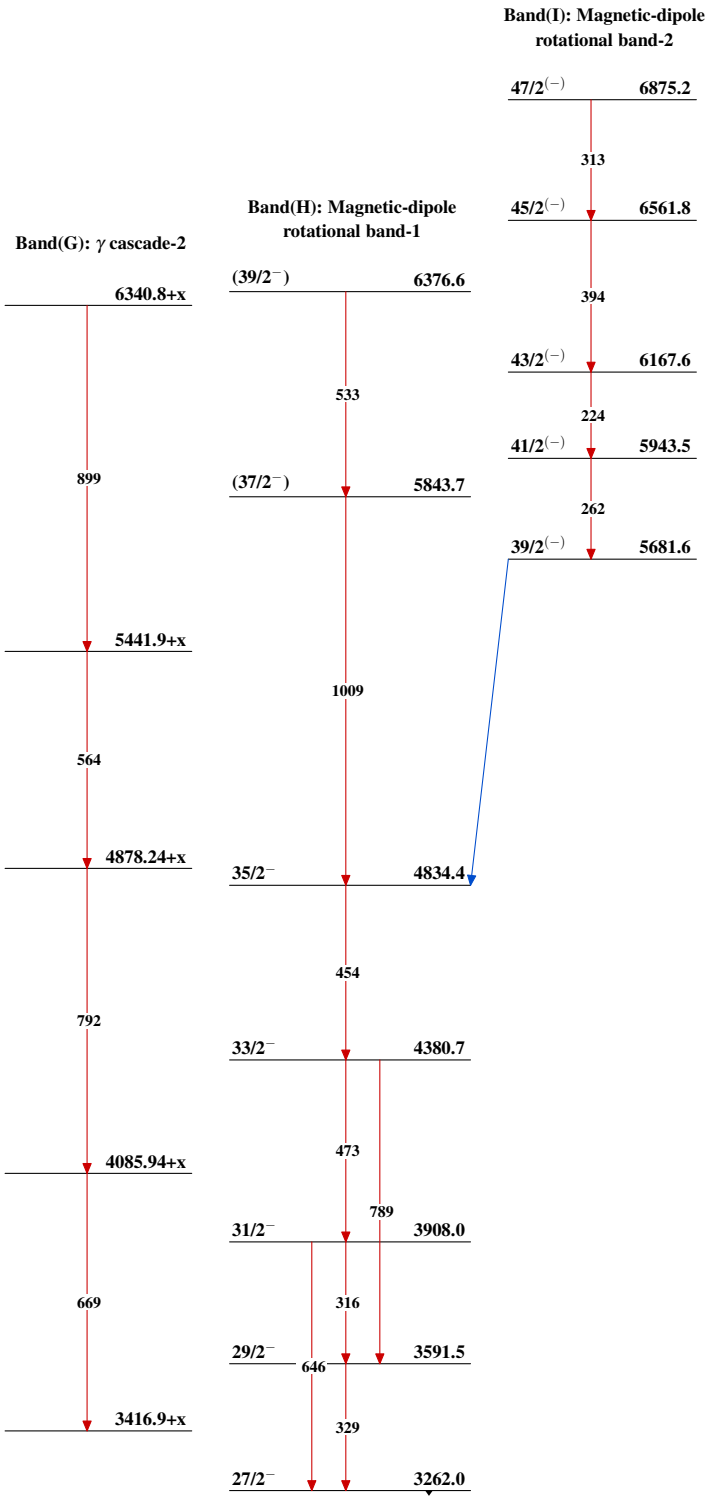
$^{139}_{61}Pm_{78}$

^{116}Cd(^{27}Al,4nγ):iuac 2009Dh01



$^{139}_{61}Pm_{78}$

^{116}Cd(^{27}Al,4nγ):iuac 2009Dh01 (continued)



$^{139}_{61}Pm_{78}$