^{106}Cd(^{36}Ar,2p2nγ) 2011Pr02,2011Pr10,1998Cu03

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

2011Pr02: E=180 MeV ^{36}Ar beam was produced from the K130 cyclotron at the Accelerator Laboratory of the University of Jyvaskyla incident on a 1 mg/cm^2 ^{106}Cd foil. Recoils were separated by the Recoil Ion Transport Unit (RITU) gas-filled recoil separator and transported to the GREAT focal-plane spectrometer and DSSDs detectors. γ rays were detected with the JUROGAM II γ-ray spectrometer consisting of 39 Compton-suppressed Ge detectors (15 Eurogam phase I detectors and 24 Clover detectors). Measured Eγ, Iγ, γγ-coin, γ(θ), recoil-decay tagging. Deduced levels, J, π, half-life, band structures, γ-ray multipolarities. Comparison with potential-energy surface calculations.

2011Pr10: E=190 MeV ^{36}Ar beam was produced from the K130 cyclotron incident on a 0.6 mg/cm^2 thick ^{106}Cd foil. γ rays were detected with the JUROGAM II spectrometer and recoils were separated by the RITU spectrometer and implanted into the DSSDs detectors at the focal plane of the GREAT spectrometer. Measured Eγ, Iγ, γγ-coin, recoil-distance Doppler shift (RDDS). Deduced half-lives with the differential decay curve analysis method. Comparison of extracted B(E2) values with predictions of X(5), and IBM-1 calculations.

1998Cu03: E=180 MeV ^{36}Ar beam was produced from the K130 cyclotron incident on a 550 μg/cm^2 thick ^{106}Cd foil. γ rays were detected with the JUROSPHERE spectrometer (23 Compton-suppressed HPGe) and were separated and implanted into the Si-strip detector at the focal plane of the RITU spectrometer. Measured Eγ, Iγ, γ(θ), γγ-coin. Deduced levels, J, π, band structures.

^{138}Gd Levels

E(level)[†]	Jπ[‡]	$T_{1/2}$[#]	Comments
0[@]	0+		
221.0[@] *10*	2+	213 ps *12*	
605.0[@] *15*	4+	9.2 ps *12*	
1094.0[@] *18*	6+	2.6 ps *10*	
1650.0[@] *20*	8+	1.3 ps *3*	
2233.0[&] *23*	8−	6.2 μs *2*	$T_{1/2}$: from (recoil)γ(t) (2011Pr02); weighted average of results from five γ rays of 221, 384, 489, 556 and 583 keV.
2628.6[&] *23*	9−		
3044.2[&] *23*	10−		
3471.9[&] *23*	11−		
3904.6[&] *23*	12−		
4306.3[&] *23*	13−		
4362.7[a] *23*	(13−)		
4567.4[a] *23*	(14−)		
4685.2[b] *23*	14−		
4776.9[a] *23*	(15−)		
4857.7[b] *23*	15−		
5029.8[a] *23*	(16−)		
5087.6[b] *24*	16−		
5329.4[a] *23*	(17−)		
5372.6[b] *24*	17−		
5682.3[a] *24*	(18−)		
5715.0[b] *24*	18−		
6072.2[a] *25*	(19−)		
6135.3[b] *24*	(19−)		
6501[b] *3*	(20−)		

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^{106}Cd(^{36}Ar,2p2nγ) 2011Pr02,2011Pr10,1998Cu03 (continued)

^{138}Gd Levels (continued)

† From a least-squares fit to γ-ray energies. For Eγ values without uncertainties, ΔEγ=1 keV is assumed in the fitting procedure.
‡ From 2011Pr02 based on deduced γ-ray multipolarities and band structure.
# From 2011Pr10 using the recoil-distance Doppler-shift (RDDS) technique with the differential decay curve analysis method (DDCM), unless otherwise noted.
@ Band(A): g.s. band.
& Band(B): $K^\pi=8^-$ band. Configuration=ν9/2[514]$\otimes\nu$7/2[404].
[a] Band(C): $K^\pi=(12^-)$, 4-qp band. Configuration=ν(9/2[514],7/2[404])$\otimes\pi$(3/2[411],5/2[413]).
[b] Band(D): $K^\pi=(14^-)$, 4-qp band Configuration=ν(9/2[514],7/2[404])$\otimes\pi$(5/2[532],7/2[523]).

γ(^{138}Gd)

E_γ†	I_γ†	E_i(level)	J_i^π	E_f	J_f^π	Mult.‡	δ‡	Comments
172.5 *2*	30 *1*	4857.7	15⁻	4685.2	14⁻	M1+E2	+	A_2=−0.21 *7*; A_4=+0.02 *1* (2011Pr02) E_γ: weighted average of 172.6 *4* from 1998Cu03 and 172.5 *2* from 2011Pr02. This γ is unplaced in 1998Cu03. I_γ: weighted average of 27 *5* from 1998Cu03 and 30 *1* from 2011Pr02.
204.6 *3*	<5	4567.4	(14⁻)	4362.7	(13⁻)	[M1]		
209.4 *3*	34 *3*	4776.9	(15⁻)	4567.4	(14⁻)	M1+E2	−	A_2=−0.28 *7*; A_4=+0.01 *1* (2011Pr02) E_γ: weighted average of 208.9 *3* from 1998Cu03 and 209.6 *3* from 2011Pr02. This γ is unplaced in 1998Cu03. I_γ: weighted average of 36 *4* from 1998Cu03 and 33 *3* from 2011Pr02.
221		221.0	2⁺	0	0⁺			
230.0 *4*	21 *2*	5087.6	16⁻	4857.7	15⁻	M1+E2	+	A_2=−0.15 *8*; A_4=+0.02 *2* (2011Pr02) E_γ: unweighted average of 229.4 *3* from 1998Cu03 and 230.2 *2* from 2011Pr02. This γ is unplaced in 1998Cu03. I_γ: weighted average of 23 *4* from 1998Cu03 and 21 *2* from 2011Pr02.
253.0 *4*	33 *3*	5029.8	(16⁻)	4776.9	(15⁻)	M1+E2	−	A_2=−0.35 *7*; A_4=+0.02 *1* (2011Pr02) E_γ: unweighted average of 252.6 *2* from 1998Cu03 and 253.3 *2* from 2011Pr02. This γ is unplaced in 1998Cu03. I_γ: weighted average of 39 *6* from 1998Cu03 and 31 *3* from 2011Pr02.
261.1 *3*	32 *1*	4567.4	(14⁻)	4306.3	13⁻	M1+E2	−	A_2=+0.55 *15*; A_4=+0.01 *1* (2011Pr02) E_γ: weighted average of 260.8 *3* from 1998Cu03 and 261.3 *3* from 2011Pr02. This γ is unplaced in 1998Cu03. I_γ: weighted average of 34 *4* from 1998Cu03 and 32 *1* from 2011Pr02.
285.0 *2*	33 *3*	5372.6	17⁻	5087.6	16⁻	M1+E2	+	A_2=−0.13 *4*; A_4=+0.01 *1* (2011Pr02) E_γ: weighted average of 284.8 *4* from 1998Cu03 and 285.1 *2* from 2011Pr02. This γ is unplaced in 1998Cu03. I_γ: weighted average of 32 *4* from 1998Cu03 and 34 *3* from 2011Pr02.
299.8 *4*	14 *3*	5329.4	(17⁻)	5029.8	(16⁻)	M1+E2	−	A_2=−0.28 *+4−7*; A_4=+0.01 *1* (2011Pr02) E_γ: weighted average of 298.5 *4* from 1998Cu03 and 299.1 *4* from 2011Pr02. This γ is unplaced in 1998Cu03. I_γ: weighted average of 12 *4* from 1998Cu03 and 15 *3* from 2011Pr02.
342.5 *3*	29 *3*	5715.0	18⁻	5372.6	17⁻	M1+E2	+	A_2=−0.15 *4*; A_4=0.00 *1* (2011Pr02) E_γ: weighted average of 342.7 *2* from 1998Cu03 and 342.2 *2* from 2011Pr02. This γ is unplaced in 1998Cu03. I_γ: weighted average of 32 *4* from 1998Cu03 and 27 *3* from 2011Pr02.
352.9 *2*	10 *3*	5682.3	(18⁻)	5329.4	(17⁻)	M1+E2	+	A_2=−0.30 *7*; A_4=+0.02 *1* (2011Pr02)

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^{106}Cd(^{36}Ar,2p2nγ) 2011Pr02,2011Pr10,1998Cu03 (continued)

γ(^{138}Gd) (continued)

E_γ †	I_γ †	E_i(level)	J^π_i	E_f	J^π_f	Mult.‡	δ‡	Comments
366.1 *8*	6 *1*	6501	(20⁻)	6135.3	(19⁻)	[M1]		
378.9 *3*	22 *4*	4685.2	14⁻	4306.3	13⁻	M1+E2	−	A_2=−0.49 *7*; A_4=+0.01 *1* (2011Pr02)
384		605.0	4⁺	221.0	2⁺			
389.9 *7*	12 *2*	6072.2	(19⁻)	5682.3	(18⁻)	[M1]		
395.7 *2*	100 *2*	2628.6	9⁻	2233.0	8⁻	M1+E2	−	A_2=−0.66 *6*; A_4=+0.02 *1* (2011Pr02) E_γ: weighted average of 395.5 *2* from 1998Cu03 and 395.8 *2* from 2011Pr02. I_γ: from 2011Pr02. Other: 100 *7* from 1998Cu03.
402.1 *2*	34 *4*	4306.3	13⁻	3904.6	12⁻	M1+E2	−	A_2=−0.71 *1*; A_4=+0.03 *1* (2011Pr02) E_γ: weighted average of 402.0 *2* from 1998Cu03 and 402.2 *2* from 2011Pr02. This γ is unplaced in 1998Cu03. I_γ: weighted average of 41 *5* from 1998Cu03 and 31 *3* from 2011Pr02.
414.9 *9*	3 *2*	4776.9	(15⁻)	4362.7	(13⁻)	[E2]		
416.2 *3*	54 *5*	3044.2	10⁻	2628.6	9⁻	M1+E2	−	A_2=−0.56 *10*; A_4=+0.01 *2* (2011Pr02) E_γ: from 2011Pr02, 414.8 *1* from 1998Cu03. 2011Pro2 also report a 414.9γ depopulating a level at 4363 keV. I_γ: weighted average of 49 *6* from 1998Cu03 and 57 *5* from 2011Pr02.
420.4 *6*	10 *2*	6135.3	(19⁻)	5715.0	18⁻	[M1]		
427.7 *1*	44 *5*	3471.9	11⁻	3044.2	10⁻	M1+E2	−	A_2=+0.72 *10*; A_4=+0.03 *1* (2011Pr02) E_γ: weighted average of 427.6 *1* from 1998Cu03 and 428.1 *2* from 2011Pr02. I_γ: weighted average of 41 *5* from 1998Cu03 and 48 *6* from 2011Pr02.
433.0 *2*	33 *6*	3904.6	12⁻	3471.9	11⁻	M1+E2	−	A_2=−0.61 *10*; A_4=+0.02 *+3−1* (2011Pr02) E_γ: weighted average of 433.0 *3* from 1998Cu03 and 433.0 *2* from 2011Pr02. I_γ: weighted average of 40 *5* from 1998Cu03 and 28 *4* from 2011Pr02.
458.6# *7*	<4	4362.7	(13⁻)	3904.6	12⁻	[M1]		
462.4 *2*	9 *6*	5029.8	(16⁻)	4567.4	(14⁻)	[E2]		
489		1094.0	6⁺	605.0	4⁺			
514.6 *12*	11 *3*	5372.6	17⁻	4857.7	15⁻	[E2]		
552.8 *13*	11 *3*	5329.4	(17⁻)	4776.9	(15⁻)	[E2]		
556		1650.0	8⁺	1094.0	6⁺			
583		2233.0	8⁻	1650.0	8⁺			
626.8 *8*	26 *3*	5715.0	18⁻	5087.6	16⁻	[E2]		
651.2 *9*	12 *2*	5682.3	(18⁻)	5029.8	(16⁻)	[E2]		
663.0 *11*	21 *3*	4567.4	(14⁻)	3904.6	12⁻	E2		A_2=+0.38 *3*; A_4=−0.13 *2* (2011Pr02)
762.6 *8*	13 *5*	6135.3	(19⁻)	5372.6	17⁻	[E2]		
780.0 *10*	9 *4*	4685.2	14⁻	3904.6	12⁻	[E2]		
810.9 *3*	36 *4*	3044.2	10⁻	2233.0	8⁻	E2		A_2=+0.28 *3*; A_4=−0.05 *2* (2011Pr02) E_γ: weighted average of 810.5 *5* from 1998Cu03 and 811.1 *3* from 2011Pr02. I_γ: weighted average of 39 *6* from 1998Cu03 and 35 *4* from 2011Pr02.
834.0 *2*	32 *5*	4306.3	13⁻	3471.9	11⁻	E2		A_2=+0.15 *3*; A_4=−0.01 *1* (2011Pr02) E_γ,I_γ: from 2011Pr02. 1998Cu03 reports an unplaced 832.4γ with Iγ=58 *7*.
842.9 *4*	48 *3*	3471.9	11⁻	2628.6	9⁻	E2		A_2=+0.18 *+13−7*; A_4=−0.02 *+1−5* (2011Pr02) E_γ: weighted average of 843.2 *5* from 1998Cu03 and 842.7 *4* from 2011Pr02. I_γ: weighted average of 54 *14* from 1998Cu03 and 48 *3* from 2011Pr02.

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$^{106}Cd(^{36}Ar,2p2n\gamma)$ 2011Pr02,2011Pr10,1998Cu03 (continued)

$\gamma(^{138}Gd)$ (continued)

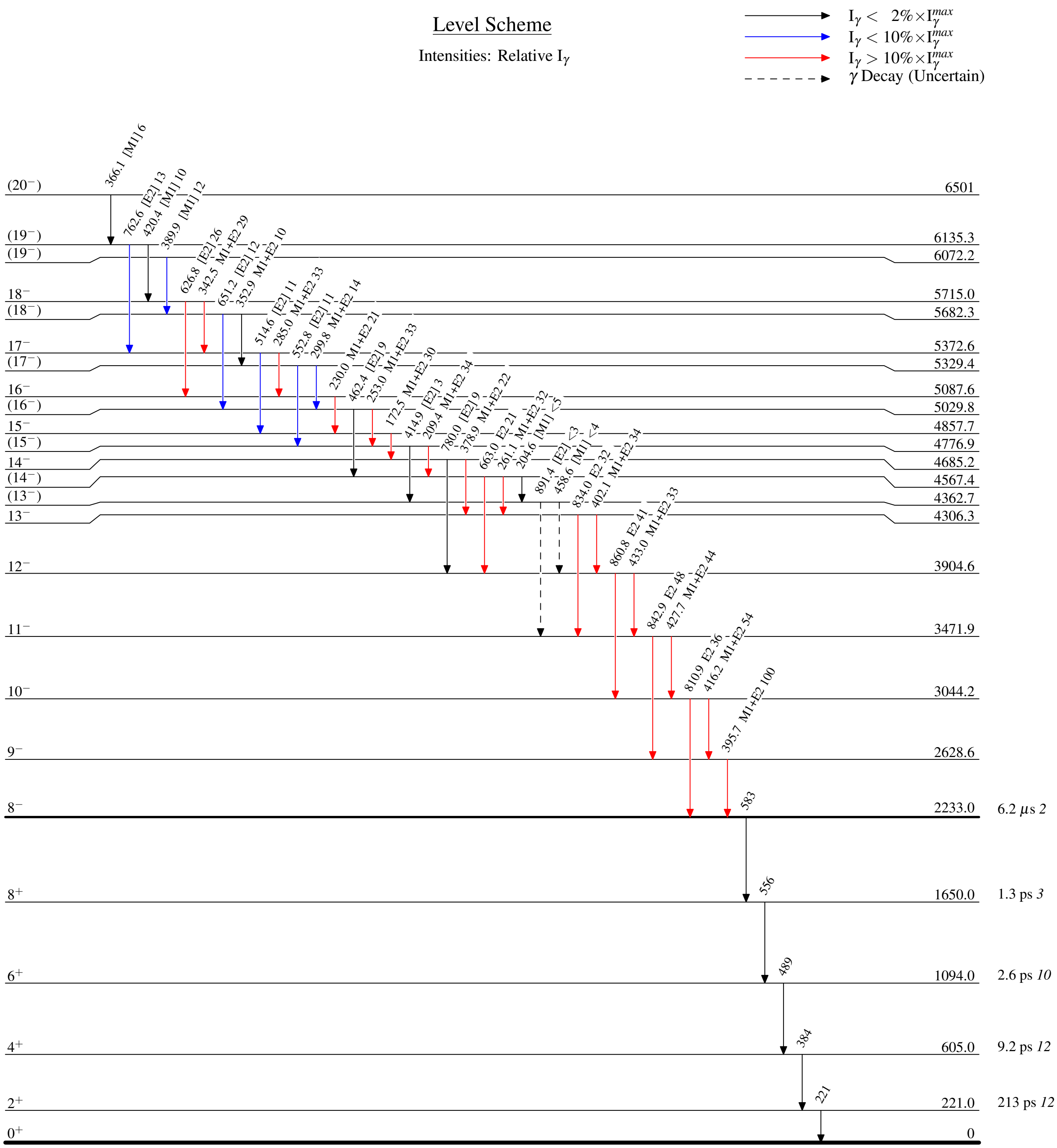
E_γ †	I_γ †	E_i(level)	J_i^π	E_f	J_f^π	Mult. ‡	Comments
							I_γ: weighted average of 54 *14* from 1998Cu03 and 48 *3* from 2011Pr02.
860.8 *4*	41 *3*	3904.6	12^-	3044.2	10^-	E2	A_2=+0.12 *+11−8*; A_4=−0.03 *+1−4* (2011Pr02) E_γ: weighted average of 860.7 *5* from 1998Cu03 and 860.8 *4* from 2011Pr02. I_γ: from 2011Pr02, 23 *4* from 1998Cu03.
891.4# *7*	<3	4362.7	(13^-)	3471.9	11^-	[E2]	

† From 2011Pr02, unless otherwise noted. Iγ is relative to Iγ(395.5γ)=100.

‡ From γ(θ) data and band structure in 2011Pr02.

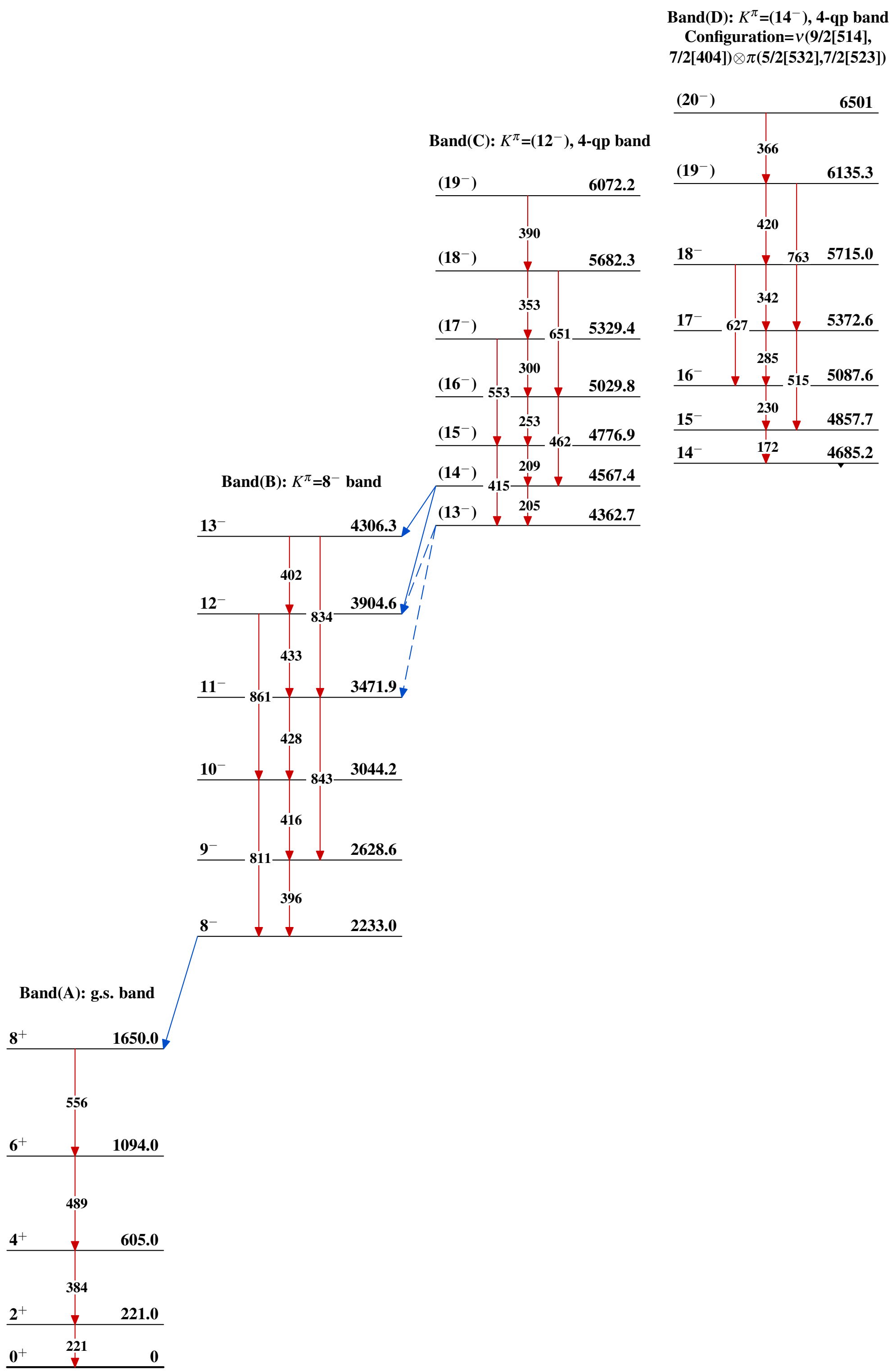
Placement of transition in the level scheme is uncertain.

$^{106}Cd(^{36}Ar,2p2n\gamma)$ 2011Pr02,2011Pr10,1998Cu03



$^{138}_{64}Gd_{74}$

$^{106}Cd(^{36}Ar,2p2n\gamma)$ 2011Pr02,2011Pr10,1998Cu03



$^{138}_{64}Gd_{74}$