^{106}Cd(^{60}Ni,2pγ) 2016Jo01

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh and Jun Chen#	NDS 147, 1 (2018)	30-Nov-2017

Includes 2017Do06: ^{92}Mo(^{78}Kr,α2pγ),E=380 MeV; measured lifetime of the first 2$^+$ state by recoil-distance Doppler-shift (RDDS) method using DPUNS differential plunger device and RITU separator at Jyvaskyla.

2016Jo01: E=270 MeV. Target=1.0 mg/cm^2 thick, 96.5% enriched ^{106}Cd self-supporting foil. Measured Eγ, Iγ, $\gamma\gamma$-coin, $\gamma\gamma(\theta)$(DCO), recoil implants, (implants)γ-coin. Recoil-decay tagging technique using RITU gas-filled separator and GREAT spectrometer and JUROGAM array at University of Jyvaskyla accelerator laboratory. Deduced high-spin levels, J^π, bands, configurations, alignments. Comparison with predictions of cranked shell-model calculations.

Other: 1992DrZU (also 1992DrZW): ^{109}Ag(^{58}Ni,2npγ) E=253 MeV. Measured Eγ, γ(x-ray) coin. The authors report two bands in the alignment plots only: a positive-parity band of 14 transitions and two negative-parity bands (possibly signature partners) with eight transitions in one and seven in the other. The energy range of the transitions in the negative-parity bands is estimated as ≈300 keV to 800 keV from the alignment plot. All three bands are reported in 2016Jo01, where the second author is the first author of 1992DrZU.

^{164}W Levels

Quasiparticle orbital labeling scheme:
A: $\nu i_{13/2}$,α=+1/2; first orbital.
B: $\nu i_{13/2}$,α=−1/2; first orbital.
E: $\nu(h_{9/2},f_{7/2})$,α=+1/2; first orbital.
F: $\nu(h_{9/2},f_{7/2})$,α=−1/2; first orbital.
G: $\nu(h_{9/2},f_{7/2})$,α=+1/2; second orbital.
H: $\nu(h_{9/2},f_{7/2})$,α=−1/2; second orbital.
e: $\pi h_{11/2}$,α=+1/2; first orbital.
f: $\pi h_{11/2}$,α=+1/2; first orbital.

E(level)†	J$^\pi$‡	T$_{1/2}$	Comments
0.0#	0$^+$		
331.9# *5*	2$^+$	18 ps *12*	T$_{1/2}$: mean lifetime τ=26 ps *17* from RDDS method (2017Do06).
822.4# *7*	4$^+$		
1429.2# *8*	6$^+$		
1480.0& *10*	(2$^-$)		
1757.6@ *8*	(5$^-$)		
1823.5& *10*	(4$^-$)		
2115.1# *9*	8$^+$		
2181.4@ *9*	(7$^-$)		
2238.6& *9*	(6$^-$)		
2572.6& *9*	(8$^-$)		
2632.4@ *9*	(9$^-$)		
2718.4& *10*	(10$^-$)		
2829.7# *10*	10$^+$		
2906.0@ *10*	(11$^-$)		
2906.5 *12*	(10$^+$)		
3119.7 *14*	(11$^-$)		
3133.0& *11*	(12$^-$)		
3325.7@ *11*	(13$^-$)		
3438.5# *11*	(12$^+$)		

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^{106}Cd(^{60}Ni,2pγ) 2016Jo01 (continued)

^{164}W Levels (continued)

E(level)†	Jπ‡	E(level)†	Jπ‡	E(level)†	Jπ‡	E(level)†	Jπ‡
3673.5& *12*	(14⁻)	4902.5# *14*	(18⁺)	6190.2# *16*	(22⁺)	7665.2# *20*	(26⁺)
3830.4# *12*	(14⁺)	4966.4& *14*	(18⁻)	6466.5& *18*	(22⁻)	8122.2& *29*	(26⁻)
3877.4@ *12*	(15⁻)	5232.2@ *14*	(19⁻)	6778.5@ *16*	(23⁻)	8463.5# *22*	(28⁺)
4292.6& *13*	(16⁻)	5523.9# *15*	(20⁺)	6900.6# *17*	(24⁺)	8468.0?@ *28*	(27⁻)
4338.4# *13*	(16⁺)	5691.0& *15*	(20⁻)	7282.9& *21*	(24⁻)	9303.6# *24*	(30⁺)
4524.6@ *13*	(17⁻)	5985.9@ *15*	(21⁻)	7600.9@ *19*	(25⁻)		

† From least-squares fit to Eγ values.

‡ As proposed by 2016Jo01, based on $\gamma\gamma(\theta)$(DCO) data.

Band(A): g.s. band. Configuration=$\nu i^2_{13/2}$ before the band crossing at $\hbar\omega\approx$0.3 MeV, $\nu i^2_{13/2}\otimes\nu$(AB) after the crossing.

@ Band(B): Band based on (5⁻). Configuration=$\nu i_{13/2}\otimes\nu(h_{9/2},f_{7/2})$ before the band crossing at $\hbar\omega\approx$0.2 MeV, $\nu i_{13/2}\otimes\nu(h_{9/2},f_{7/2})$(AE) after the crossing.

& Band(C): Band based on (2⁻). Configuration=$\nu i_{13/2}\otimes\nu(h_{9/2},f_{7/2})$ before the band crossing at $\hbar\omega\approx$0.2 MeV, $\nu i_{13/2}\otimes\nu(h_{9/2},f_{7/2})$(AF) after the crossing.

γ(^{164}W)

The DCO ratios are for 90° and 158° geometry, with gates on ΔJ=2, quadrupole transitions. For a guide, DCO values for known transitions were 0.94 *9* for 490, 4⁺ –> 2⁺ transition, and 0.67 *14* for 752, 7⁻ –> 6⁺ transition.

Eγ†	Iγ	Ei(level)	Jπi	Ef	Jπf	Mult.‡	α#	Comments
85.8 *20*	<2.0	2718.4	(10⁻)	2632.4	(9⁻)			
145.7 *5*	11.2 *9*	2718.4	(10⁻)	2572.6	(8⁻)	(E2)		DCO=1.3 *6*
187.4 *5*	11.2 *8*	2906.0	(11⁻)	2718.4	(10⁻)			
273.7 *5*	16.3 *11*	2906.0	(11⁻)	2632.4	(9⁻)	(E2)		DCO=1.3 *3*
331.9 *5*	100.0 *6*	331.9	2⁺	0.0	0⁺	E2	0.0632	DCO=0.8 *1* B(E2)(W.u.)=150 *100* (2017Do06), but the evaluators obtain B(E2)(W.u.)=138 *+276−55* using upper and lower bounds of half-life. Mult.: from DCO and RUL.
334.0 *5*	11.7 *10*	2572.6	(8⁻)	2238.6	(6⁻)			
343.6 *5*	5.0 *8*	1823.5	(4⁻)	1480.0	(2⁻)			
391.0 *5*	10.7 *11*	2572.6	(8⁻)	2181.4	(7⁻)			
391.9 *5*	34.6 *23*	3830.4	(14⁺)	3438.5	(12⁺)			
414.6 *5*	22.0 *16*	3133.0	(12⁻)	2718.4	(10⁻)			
415.5 *10*	4.9 *7*	2238.6	(6⁻)	1823.5	(4⁻)			
419.7 *5*	28.9 *19*	3325.7	(13⁻)	2906.0	(11⁻)			
424.4 *10*	9.0 *8*	2181.4	(7⁻)	1757.6	(5⁻)			
451.0 *5*	22.1 *16*	2632.4	(9⁻)	2181.4	(7⁻)			
480.9 *10*	4.7 *7*	2238.6	(6⁻)	1757.6	(5⁻)			
487.3 *10*	2.9 *8*	3119.7	(11⁻)	2632.4	(9⁻)			
490.4 *5*	95 *6*	822.4	4⁺	331.9	2⁺	(E2)		DCO=0.9 *1*
508.0 *5*	41 *3*	4338.4	(16⁺)	3830.4	(14⁺)			
517.4 *5*	13.5 *10*	2632.4	(9⁻)	2115.1	8⁺			
531.6 *10*	6.8 *7*	3438.5	(12⁺)	2906.5	(10⁺)			
540.5 *5*	20.1 *14*	3673.5	(14⁻)	3133.0	(12⁻)			
551.7 *5*	27.5 *19*	3877.4	(15⁻)	3325.7	(13⁻)			
564.1 *5*	31.7 *21*	4902.5	(18⁺)	4338.4	(16⁺)			

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^{106}Cd(^{60}Ni,2pγ) 2016Jo01 (continued)

γ(^{164}W) (continued)

E_γ †	I_γ	E_i(level)	J_i^π	E_f	J_f^π	Mult. ‡	Comments
606.6 *5*	80 *5*	1429.2	6⁺	822.4	4⁺	Q	DCO=0.8 *1*
608.9 *5*	37 *3*	3438.5	(12⁺)	2829.7	10⁺		
619.1 *5*	17.0 *13*	4292.6	(16⁻)	3673.5	(14⁻)		
621.4 *5*	22.5 *16*	5523.9	(20⁺)	4902.5	(18⁺)		
647.2 *5*	26.9 *18*	4524.6	(17⁻)	3877.4	(15⁻)		
666.3 *5*	20.5 *15*	6190.2	(22⁺)	5523.9	(20⁺)		
673.8 *5*	15.1 *11*	4966.4	(18⁻)	4292.6	(16⁻)		
686.0 *5*	55 *4*	2115.1	8⁺	1429.2	6⁺	Q	DCO=1.7 *4*
707.6 *5*	18.0 *13*	5232.2	(19⁻)	4524.6	(17⁻)		
710.4 *5*	13.1 *10*	6900.6	(24⁺)	6190.2	(22⁺)		
714.7 *5*	37 *3*	2829.7	10⁺	2115.1	8⁺	Q	DCO=1.2 *2*
724.6 *5*	12.5 *10*	5691.0	(20⁻)	4966.4	(18⁻)		
751.9 *5*	25.6 *21*	2181.4	(7⁻)	1429.2	6⁺	D	DCO=0.7 *1*
753.7 *5*	12.5 *11*	5985.9	(21⁻)	5232.2	(19⁻)		
764.6 *10*	9.2 *8*	7665.2	(26⁺)	6900.6	(24⁺)		
775.5 *10*	7.0 *7*	6466.5	(22⁻)	5691.0	(20⁻)		
791.0 *10*	5.6 *11*	2906.5	(10⁺)	2115.1	8⁺		
792.6 *5*	7.5 *7*	6778.5	(23⁻)	5985.9	(21⁻)		
798.3 *10*	6.1 *6*	8463.5	(28⁺)	7665.2	(26⁺)		
816.4 *10*	3.7 *5*	7282.9	(24⁻)	6466.5	(22⁻)		
822.4 *10*	4.1 *5*	7600.9	(25⁻)	6778.5	(23⁻)		
839.3 *20*	1.8 *4*	8122.2	(26⁻)	7282.9	(24⁻)		
840.1 *10*	2.1 *4*	9303.6	(30⁺)	8463.5	(28⁺)		
867.1@ *20*	1.7 *4*	8468.0?	(27⁻)	7600.9	(25⁻)		
935.3 *5*	11.9 *15*	1757.6	(5⁻)	822.4	4⁺		
1001.2 *20*	1.3 *4*	1823.5	(4⁻)	822.4	4⁺		
1148.5 *10*	3.6 *15*	1480.0	(2⁻)	331.9	2⁺		

† 2016Jo01 assign uncertainty of 0.5 keV for γ rays with Iγ>10, up to 2 keV for weaker γ rays. Evaluators assign 1.0 keV for γ rays with Iγ=2-10, and 2.0 keV for Iγ<2.

‡ Assigned by evaluators based on DCO ratios, combined with RUL (for E2 and M2) assuming level half-lives are less than 20 ns, typical resolution time in $\gamma\gamma$-coincidence experiments. Mult=Q indicates ΔJ=2 transition, most likely E2, while mult=D indicates ΔJ=1 transition.

Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

@ Placement of transition in the level scheme is uncertain.

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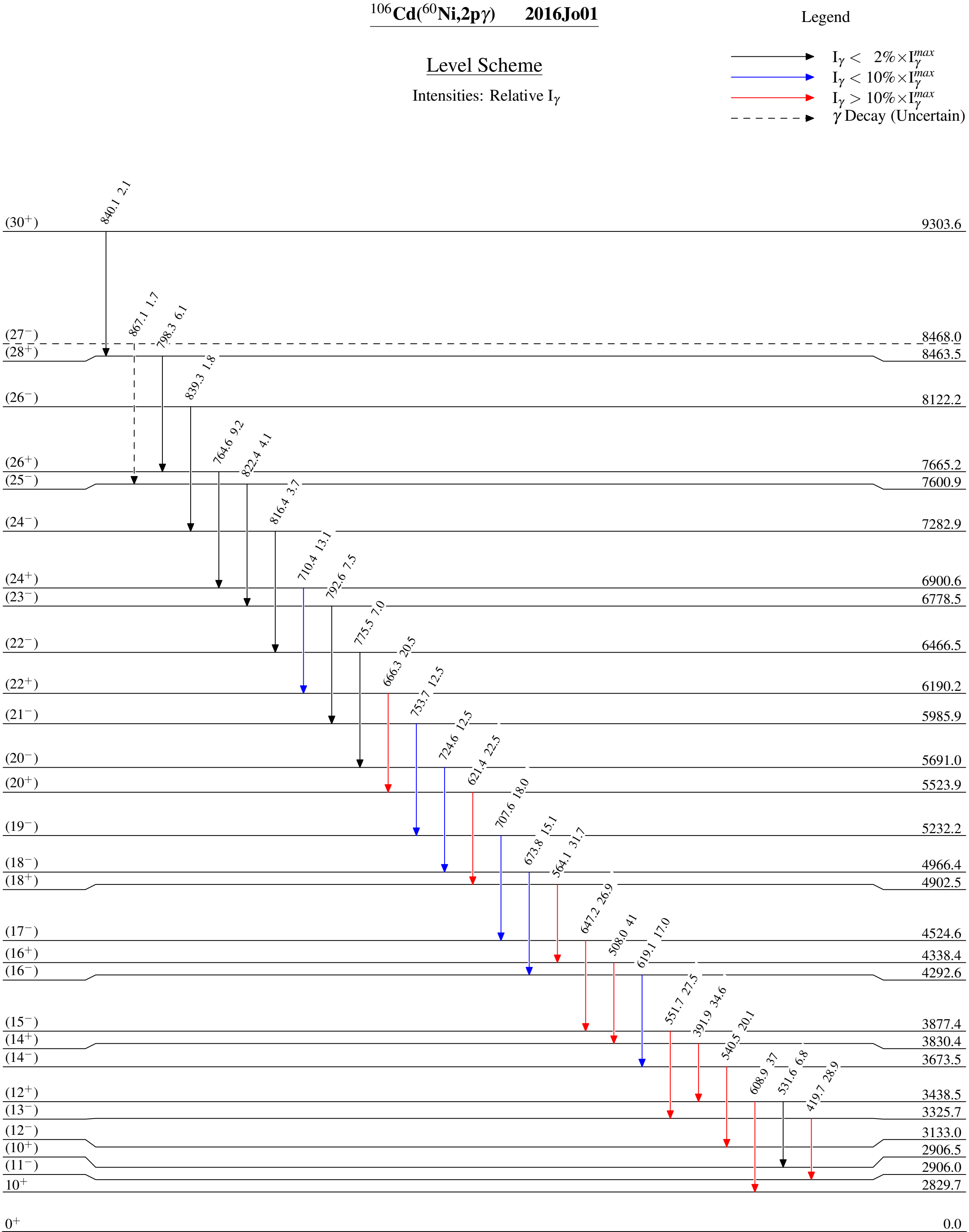
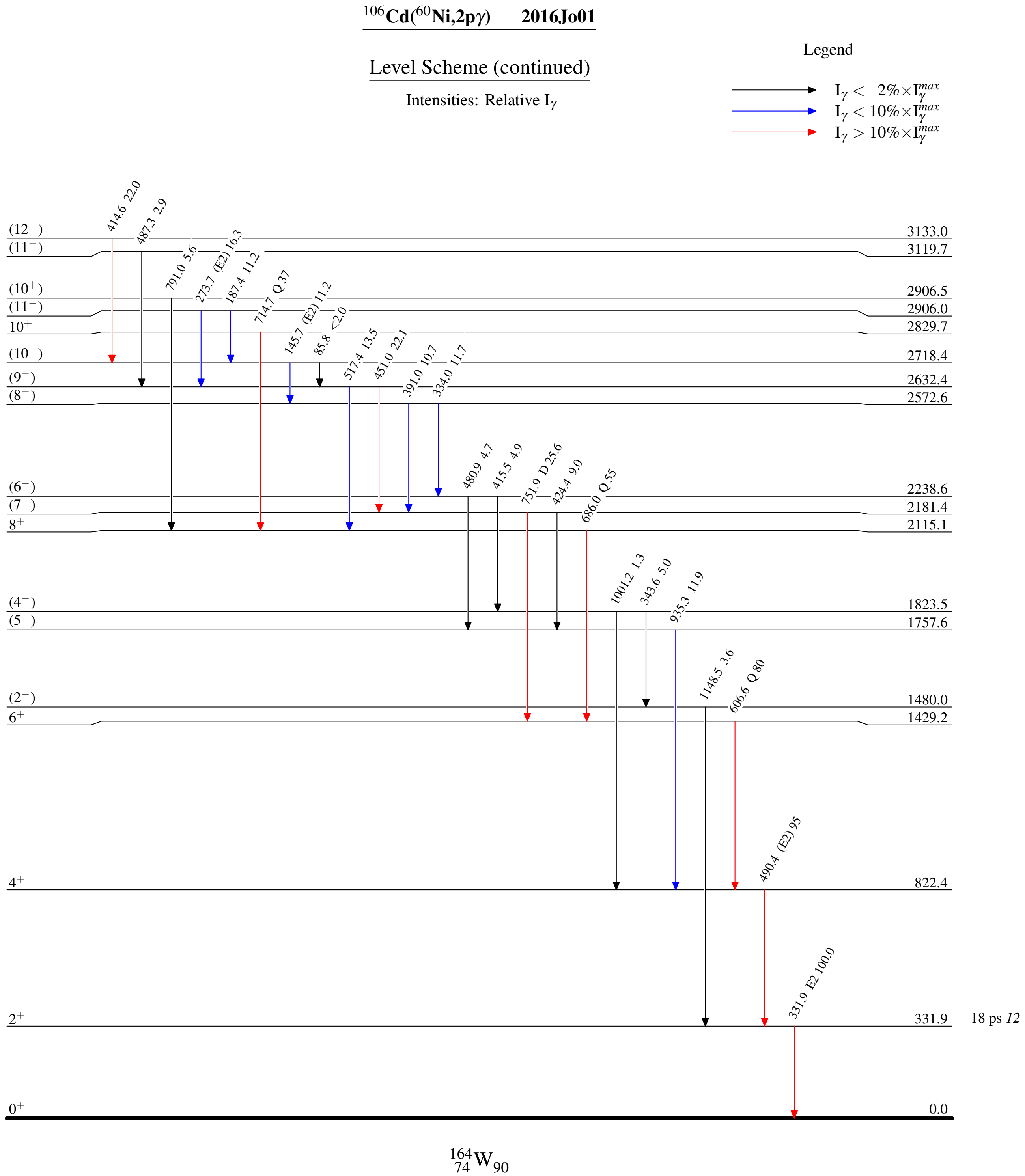
Level Scheme

Intensities: Relative I_γ

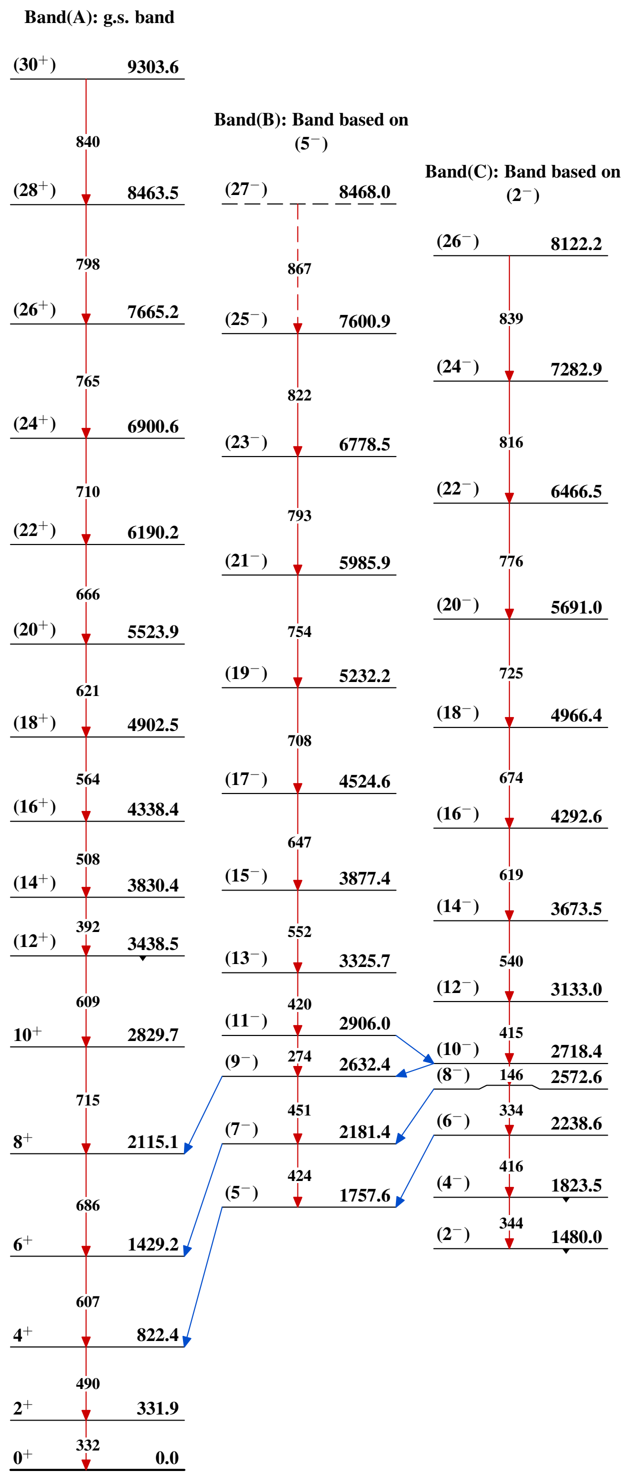


$^{164}_{74}W_{90}$



^{106}Cd(^{60}Ni,2pγ) 2016Jo01
Level Scheme (continued)
Intensities: Relative Iγ
Legend
Iγ < 2%×Iγ^max
Iγ < 10%×Iγ^max
Iγ > 10%×Iγ^max
(12⁻) 3133.0
(11⁻) 3119.7
(10⁺) 2906.5
(11⁻) 2906.0
10⁺ 2829.7
(10⁻) 2718.4
(9⁻) 2632.4
(8⁻) 2572.6
(6⁻) 2238.6
(7⁻) 2181.4
8⁺ 2115.1
(4⁻) 1823.5
(5⁻) 1757.6
(2⁻) 1480.0
6⁺ 1429.2
4⁺ 822.4
2⁺ 331.9 18 ps 12
0⁺ 0.0
414.6 22.0
487.3 2.9
791.0 5.6
273.7 (E2) 16.3
187.4 11.2
714.7 Q 37
145.7 (E2) 11.2
85.8 <2.0
517.4 13.5
451.0 22.1
391.0 10.7
334.0 11.7
480.9 4.7
415.5 4.9
751.9 D 25.6
424.4 9.0
686.0 Q 55
1001.2 1.3
343.6 5.0
935.3 11.9
1148.5 3.6
606.6 Q 80
490.4 (E2) 95
331.9 E2 100.0
$^{164}_{74}W_{90}$

$^{106}Cd(^{60}Ni,2p\gamma)$ 2016Jo01



$^{164}_{74}W_{90}$