

$^{237}\text{Np}(^{209}\text{Bi},\gamma)$ **2004Ab16,2002AbZV**

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	M. S. Basunia	NDS 107, 3323 (2006)	15-Mar-2006

2004Ab16,2002AbZV: Target: ~99% enriched ^{237}Np ; Projectile: ^{209}Bi , E=1450 MeV; Detector: Gammasphere, an array of 101 Compton suppressed HPGe detectors; Measured: $E\gamma$, $I\gamma$, $\gamma\gamma\gamma$ coin.

 ^{237}Np Levels

E(level) [†]	$J^{\pi\ddagger}$	E(level) [†]	$J^{\pi\ddagger}$	E(level) [†]	$J^{\pi\ddagger}$	E(level) [†]	$J^{\pi\ddagger}$
0.0 [#]	5/2 ⁺	544.0 [#] 4	21/2 ⁺	1652.2 ^{&} 8	33/2 ⁻	3300.0 ^{&} 12	49/2 ⁻
33.19628 [@] 22	7/2 ⁺	608.1 ^a 6	19/2 ⁻	1742.9 [#] 5	37/2 ⁺	3454.8 [@] 9	51/2 ⁺
59.54092 ^{&} 10	5/2 ⁻	680.7 [@] 4	23/2 ⁺	1823.3 ^a 8	35/2 ⁻	3480.2 ^a 13	51/2 ⁻
75.92 [#] 5	9/2 ⁺	730.4 ^{&} 6	21/2 ⁻	2022.8 [@] 9	37/2 ⁻	3531.8 [#] 10	53/2 ⁺
102.966 ^a 9	7/2 ⁻	783.3 [#] 4	25/2 ⁺	2033.9 [@] 6	39/2 ⁺	3778.9 ^{&} 13	53/2 ⁻
130.2 [@] 7	11/2 ⁺	861.8 ^a 6	23/2 ⁻	2139.0 [#] 6	41/2 ⁺	3960.4 ^a 14	55/2 ⁻
158.0 ^{&} 8	9/2 ⁻	955.0 [@] 4	27/2 ⁺	2199.7 ^a 10	39/2 ⁻	3993.5 [@] 10	55/2 ⁺
190.21 [#] 20	13/2 ⁺	1003.7 ^{&} 6	25/2 ⁻	2421.7 ^{&} 10	41/2 ⁻	4058.4 [#] 11	57/2 ⁺
225.4 ^a 4	11/2 ⁻	1063.7 [#] 5	29/2 ⁺	2472.6 [@] 6	43/2 ⁺	4287.8 ^{&}	(57/2 ⁻)
267.6 [@] 5	15/2 ⁺	1150.1 ^a 7	27/2 ⁻	2570.6 [#] 7	45/2 ⁺	4469.6 ^a	(59/2 ⁻)
304.2 ^{&} 6	13/2 ⁻	1273.5 [@] 5	31/2 ⁺	2600.7 ^a 11	43/2 ⁻	4563.6 [@] 11	59/2 ⁺
346.2 [#] 3	17/2 ⁺	1311.5 ^{&} 7	29/2 ⁻	2847.6 ^{&} 11	45/2 ⁻	4613.8 [#] 12	61/2 ⁺
394.5 ^a 4	15/2 ⁻	1383.5 [#] 5	33/2 ⁺	2946.8 [@] 7	47/2 ⁺		
451.4 [@] 5	19/2 ⁺	1472.5 ^a 7	31/2 ⁻	3027.4 ^a 12	47/2 ⁻		
495.7 ^{&} 5	17/2 ⁻	1633.3 [@] 6	35/2 ⁺	3035.3 [#] 9	49/2 ⁺		

[†] From a least squares fit to the γ -ray energies; in **2004Ab16** γ -ray uncertainty assigned as $\Delta E=0.2$ keV for the strongest transitions, $\Delta E=0.5$ keV for the weakest transitions. Evaluator assigned uncertainty to γ -ray on criteria: $I\gamma>50$ as the strongest and $I\gamma<50$ as the weakest.

[‡] From Adopted Levels and rotational structure.

[#] Band(A): 1: 5/2[642] band: $\alpha=+1/2$.

[@] Band(B): 2: 5/2[642] band: $\alpha=-1/2$.

[&] Band(C): 3: 5/2[523] band: $\alpha=+1/2$.

^a Band(D): 4: 5/2[523] band: $\alpha=-1/2$.

 $\gamma(^{237}\text{Np})$

E_{γ} [†]	I_{γ} [†]	$E_i(\text{level})$	J^{π}_i	E_f	J^{π}_f	Comments
26.3446 [‡] 2		59.54092	5/2 ⁻	33.19628	7/2 ⁺	
33.196 [‡] 1		33.19628	7/2 ⁺	0.0	5/2 ⁺	
42.73 [‡] 5		75.92	9/2 ⁺	33.19628	7/2 ⁺	
43.423 [‡] 10		102.966	7/2 ⁻	59.54092	5/2 ⁻	
54.0 [‡]		130.2	11/2 ⁺	75.92	9/2 ⁺	
59.5409 [‡] 1		59.54092	5/2 ⁻	0.0	5/2 ⁺	
69.76 [‡] 3		102.966	7/2 ⁻	33.19628	7/2 ⁺	
75.8 5	≤ 34	75.92	9/2 ⁺	0.0	5/2 ⁺	I_{γ} : $\Delta I_{\gamma}=8$ (2002AbZV).
97.1 [@] 5	≤ 45	130.2	11/2 ⁺	33.19628	7/2 ⁺	I_{γ} : $\Delta I_{\gamma}=11$ (2002AbZV).
99.0 [@] 5	≤ 30	158.0	9/2 ⁻	59.54092	5/2 ⁻	I_{γ} : $\Delta I_{\gamma}=6$ (2002AbZV).

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$^{237}\text{Np}(^{209}\text{Bi},\gamma)$ **2004Ab16,2002AbZV (continued)** $\gamma(^{237}\text{Np})$ (continued)

E_γ †	I_γ †	$E_i(\text{level})$	J_i^π	E_f	J_f^π	Mult. #	Comments
101.4 5	≤ 11	495.7	$17/2^-$	394.5	$15/2^-$		$I_\gamma: \Delta I_\gamma=8$ (2002AbZV).
102.98 ‡ 2		102.966	$7/2^-$	0.0	$5/2^+$		
105.0 @ 2	293 79	451.4	$19/2^+$	346.2	$17/2^+$	[M1+E2]	
112.6 5	19 5	608.1	$19/2^-$	495.7	$17/2^-$		
114.3 2	≤ 60	190.21	$13/2^+$	75.92	$9/2^+$		$I_\gamma: \Delta I_\gamma=14$ (2002AbZV).
122.4 5	≤ 21	225.4	$11/2^-$	102.966	$7/2^-$		$I_\gamma: \Delta I_\gamma=4$ (2002AbZV).
122.7 5	≤ 14	730.4	$21/2^-$	608.1	$19/2^-$		$I_\gamma: \Delta I_\gamma=10$ (2002AbZV).
124.9 @ 5	≤ 6	158.0	$9/2^-$	33.19628	$7/2^+$		$I_\gamma: \Delta I_\gamma=4$ (2002AbZV).
131.8 2	115 24	861.8	$23/2^-$	730.4	$21/2^-$		
136.7 2	390 47	680.7	$23/2^+$	544.0	$21/2^+$	[M1+E2]	
138.7 @ 2	267 55	267.6	$15/2^+$	130.2	$11/2^+$		
142.7 5	19 13	1003.7	$25/2^-$	861.8	$23/2^-$		
146.0 2	120 10	1150.1	$27/2^-$	1003.7	$25/2^-$		
146.2 5	≤ 40	304.2	$13/2^-$	158.0	$9/2^-$		$I_\gamma: \Delta I_\gamma=8$ (2002AbZV).
149.6 5	≤ 10.6	225.4	$11/2^-$	75.92	$9/2^+$		$I_\gamma: \Delta I_\gamma=2.9$ (2002AbZV).
156.0 2	80 19	346.2	$17/2^+$	190.21	$13/2^+$		
160.5 5	14 5	1311.5	$29/2^-$	1150.1	$27/2^-$		
161.0 2	≤ 89	1472.5	$31/2^-$	1311.5	$29/2^-$		$I_\gamma: \Delta I_\gamma=78$ (2002AbZV).
169.0 5	≤ 28	394.5	$15/2^-$	225.4	$11/2^-$		$I_\gamma: \Delta I_\gamma=6$ (2002AbZV).
171.8 2	370 21	955.0	$27/2^+$	783.3	$25/2^+$	[M1+E2]	
174.0 5	≤ 8	304.2	$13/2^-$	130.2	$11/2^+$		$I_\gamma: \Delta I_\gamma=6$ (2002AbZV).
179.6 5	12 5	1652.2	$33/2^-$	1472.5	$31/2^-$		
183.8 2	99 20	451.4	$19/2^+$	267.6	$15/2^+$		
191.5 2	54 11	495.7	$17/2^-$	304.2	$13/2^-$		
197.8 2	100 10	544.0	$21/2^+$	346.2	$17/2^+$		
199.3 5	≤ 9	2022.8	$37/2^-$	1823.3	$35/2^-$		$I_\gamma: \Delta I_\gamma=4$ (2002AbZV).
204.3 5	≤ 14	394.5	$15/2^-$	190.21	$13/2^+$		$I_\gamma: \Delta I_\gamma=4$ (2002AbZV).
209.7 2	53 49	1273.5	$31/2^+$	1063.7	$29/2^+$	[M1+E2]	
213.6 5	38 8	608.1	$19/2^-$	394.5	$15/2^-$		
229.3 2	72 85	680.7	$23/2^+$	451.4	$19/2^+$		
234.6 5	38 8	730.4	$21/2^-$	495.7	$17/2^-$		
239.3 2	120 58	783.3	$25/2^+$	544.0	$21/2^+$		
249.6 5	27 25	1633.3	$35/2^+$	1383.5	$33/2^+$		
253.4 5	18 4	861.8	$23/2^-$	608.1	$19/2^-$		
272.9 2	69 16	1003.7	$25/2^-$	730.4	$21/2^-$		
274.3 2	139 77	955.0	$27/2^+$	680.7	$23/2^+$		
280.3 2	95 47	1063.7	$29/2^+$	783.3	$25/2^+$		
289.8 5	17 5	1150.1	$27/2^-$	861.8	$23/2^-$		
291.1 5	17 5	2033.9	$39/2^+$	1742.9	$37/2^+$	[M1+E2]	
308.8 5	47 11	1311.5	$29/2^-$	1003.7	$25/2^-$		
318.6 2	55 50	1273.5	$31/2^+$	955.0	$27/2^+$		
319.8 2	158 33	1383.5	$33/2^+$	1063.7	$29/2^+$		
322.2 5	19 5	1472.5	$31/2^-$	1150.1	$27/2^-$		
333.9 5	7 6	2472.6	$43/2^+$	2139.0	$41/2^+$	[M1+E2]	
341.0 5	35 8	1652.2	$33/2^-$	1311.5	$29/2^-$		
350.6 5	14 4	1823.3	$35/2^-$	1472.5	$31/2^-$		
359.5 2	102 23	1742.9	$37/2^+$	1383.5	$33/2^+$		
359.7 5	39 35	1633.3	$35/2^+$	1273.5	$31/2^+$		
370.8 5	19 4	2022.8	$37/2^-$	1652.2	$33/2^-$		
376.1 5	≤ 5	2946.8	$47/2^+$	2570.6	$45/2^+$	[M1+E2]	$I_\gamma: \Delta I_\gamma=5$ (2002AbZV).
376.4 5	14 4	2199.7	$39/2^-$	1823.3	$35/2^-$		
396.1 2	67 14	2139.0	$41/2^+$	1742.9	$37/2^+$		
398.9 5	15 3	2421.7	$41/2^-$	2022.8	$37/2^-$		
400.3 5	47 10	2033.9	$39/2^+$	1633.3	$35/2^+$		
401.0 5	8.1 23	2600.7	$43/2^-$	2199.7	$39/2^-$		

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$^{237}\text{Np}(^{209}\text{Bi},\gamma)$ **2004Ab16,2002AbZV (continued)** $\gamma(^{237}\text{Np})$ (continued)

$E_\gamma^\dagger$	$I_\gamma^\dagger$	$E_i(\text{level})$	J_i^π	E_f	J_f^π	Mult. [#]	Comments
421.7 @ 5	≤ 4	3454.8	51/2 ⁺	3035.3	49/2 ⁺	[M1+E2]	$I_\gamma: \Delta I_\gamma=3$ (2002AbZV).
425.9 5	8.4 19	2847.6	45/2 ⁻	2421.7	41/2 ⁻		
426.7 5	4.1 14	3027.4	47/2 ⁻	2600.7	43/2 ⁻		
431.4 5	34 6	2570.6	45/2 ⁺	2139.0	41/2 ⁺		
438.5 5	32 7	2472.6	43/2 ⁺	2033.9	39/2 ⁺		
452.4 5	3.8 11	3300.0	49/2 ⁻	2847.6	45/2 ⁻		
452.8 5	2.0 9	3480.2	51/2 ⁻	3027.4	47/2 ⁻		
464.7 5	13 4	3035.3	49/2 ⁺	2570.6	45/2 ⁺		
474.4 5	8 3	2946.8	47/2 ⁺	2472.6	43/2 ⁺		
478.9 5	0.7 3	3778.9	53/2 ⁻	3300.0	49/2 ⁻		
480.2 5	0.5 3	3960.4	55/2 ⁻	3480.2	51/2 ⁻		
496.5 5	5.8 21	3531.8	53/2 ⁺	3035.3	49/2 ⁺		
507.4 @ 5	0.20 16	4287.8	(57/2 ⁻)	3778.9	53/2 ⁻		
508.0 5	5.0 21	3454.8	51/2 ⁺	2946.8	47/2 ⁺		
508.5 @ 5	0.6 12	4469.6	(59/2 ⁻)	3960.4	55/2 ⁻		
526.6 5	2.0 10	4058.4	57/2 ⁺	3531.8	53/2 ⁺		
538.7 5	4.4 18	3993.5	55/2 ⁺	3454.8	51/2 ⁺		
555.4 5	≤ 1.5	4613.8	61/2 ⁺	4058.4	57/2 ⁺		$I_\gamma: \Delta I_\gamma=0.8$ (2002AbZV).
570.1 5	≤ 3.3	4563.6	59/2 ⁺	3993.5	55/2 ⁺		$I_\gamma: \Delta I_\gamma=1.4$ (2002AbZV).

[†] From 2002AbZV, except otherwise noted.

[‡] From adopted gammas.

[#] Assigned in 2004Ab16 from out-of-band transitions between (2I+1)/2⁺ and (2I-1)/2⁺ states.

@ Placement of transition in the level scheme is uncertain.

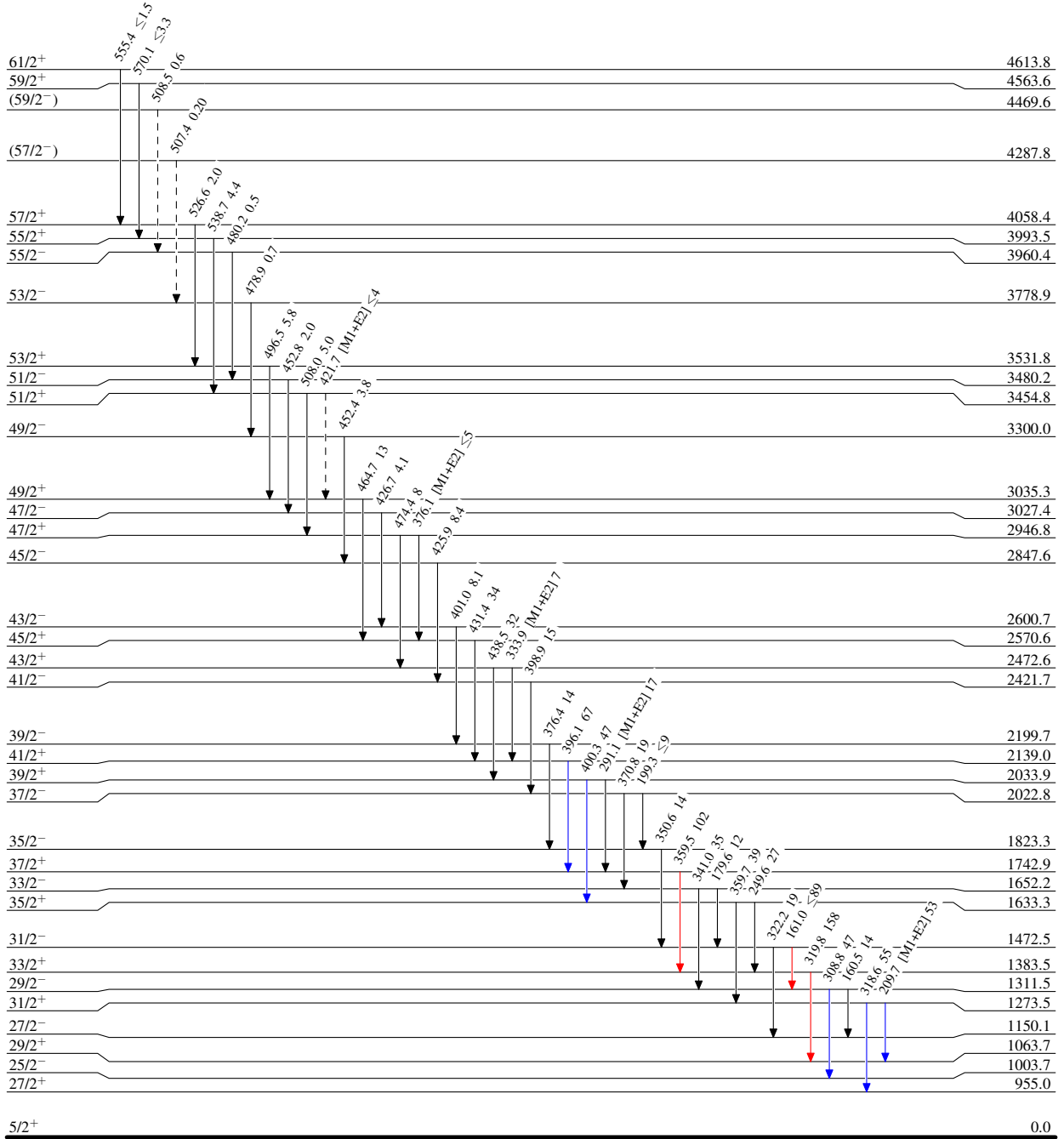
$^{237}\text{Np}(^{209}\text{Bi},\gamma)$ 2004Ab16,2002AbZV

Legend

Level Scheme

Intensities: Relative I_γ

- $\longrightarrow$ $I_\gamma < 2\% \times I_\gamma^{\max}$
 $\longrightarrow$ $I_\gamma < 10\% \times I_\gamma^{\max}$
 $\longrightarrow$ $I_\gamma > 10\% \times I_\gamma^{\max}$
 $\cdots\cdots\cdots\longrightarrow$ γ Decay (Uncertain)



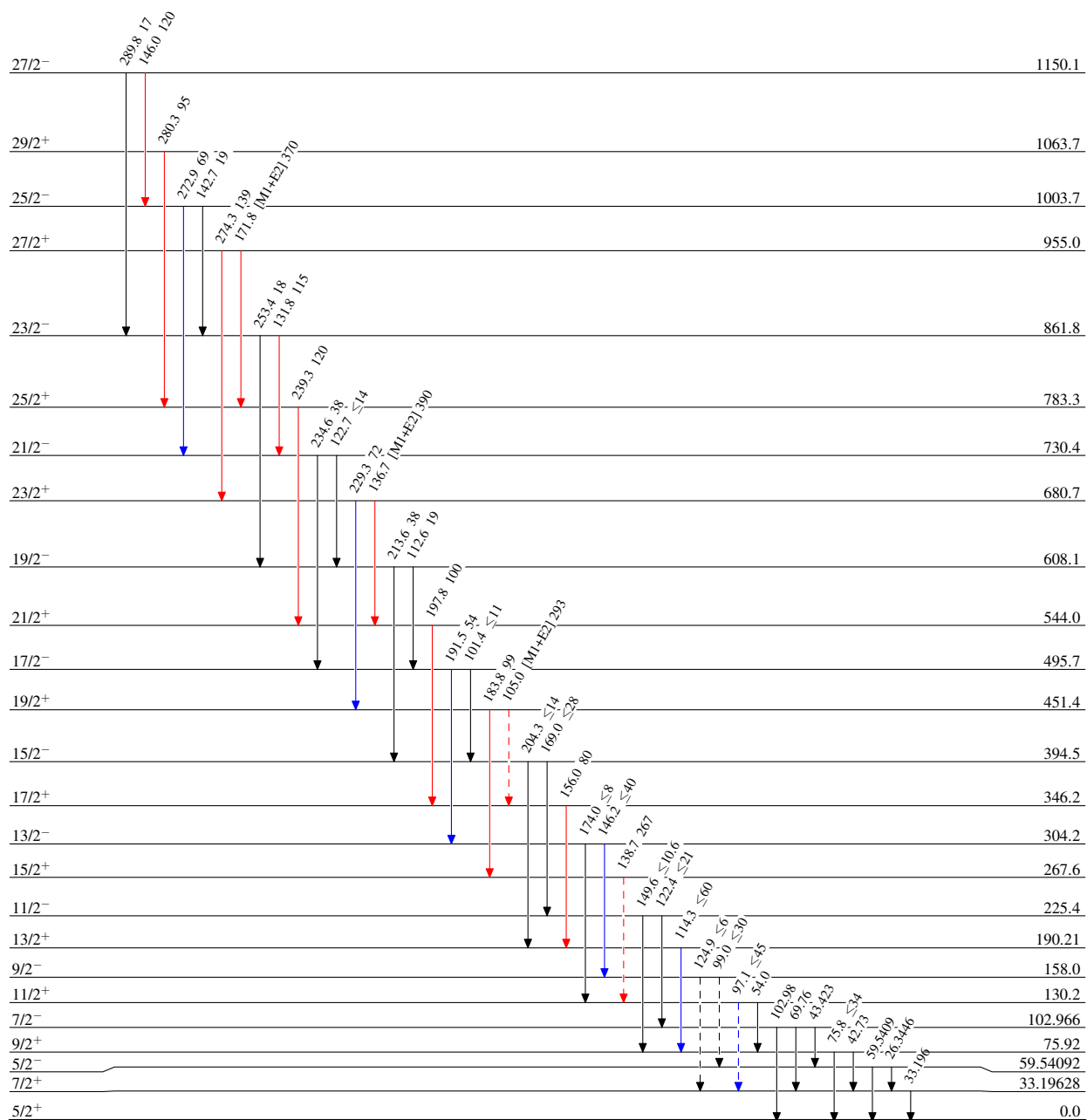
$^{237}\text{Np}(^{209}\text{Bi},\gamma)$ 2004Ab16,2002AbZV

Legend

Level Scheme (continued)

Intensities: Relative I_γ

- $\longrightarrow$ $I_\gamma < 2\% \times I_\gamma^{\max}$
 $\longrightarrow$ $I_\gamma < 10\% \times I_\gamma^{\max}$
 $\longrightarrow$ $I_\gamma > 10\% \times I_\gamma^{\max}$
 $\cdots\cdots\cdots\longrightarrow$ γ Decay (Uncertain)

 $^{237}_{93}\text{Np}_{144}$

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