

**(HI,xn $\gamma$ ) 2000Ko16,1999So01,1986Dr05**

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	E. Achterberg, O. A. Capurro, G. V. Marti		NDS 110, 1473 (2009)	31-May-2008

**2000Ko16:** Excited states of  $^{178}\text{Pt}$  were obtained from the reaction  $^{103}\text{Rh}(^{78}\text{Kr},3p)$ , at  $E=350$  MeV. Measured  $E\gamma$ ,  $I\gamma$ ,  $\gamma\gamma$ , and  $\gamma\gamma(\theta)$  (anisotropy ratio), using the Gammasphere array of 101 Compton-suppressed HPGe detectors.

**1999So01:**  $^{142}\text{Nd}(^{46}\text{Ti},2\alpha2n)$ ,  $E=230$  MeV. Measured  $E\gamma$ ,  $I\gamma$ ,  $\gamma\gamma$  with the GASP array, ISIS Silicon ball, and the RMS spectrometer for recoil mass separation.

**1986Dr05:**  $^{144}\text{Sm}(^{37}\text{Cl},p2n)$ ,  $E=170$  MeV. Measured  $E\gamma$ ,  $\gamma\gamma$  coin,  $\gamma(\theta)$ , level  $T_{1/2}$  (recoil-distance method). Detectors: anti-Compton Ge(Li) array, planar Ge(Li) for x-ray detection.

 $^{178}\text{Pt}$  Levels

E(level) <sup>†</sup>	J $\pi^{\ddagger}$	$T_{1/2}$ <sup>#</sup>	Comments
0.0 <sup>@</sup>	0 <sup>+</sup>	20.7 s 7	$T_{1/2}$ : From Adopted Levels. This level decays via two main $\alpha$ transitions with an 7.5 3 % branching ratio ( <b>2000Ko16</b> ) to levels in $^{174}\text{Os}$ : a) $E(\alpha)=5447.4$ keV, $I_{\alpha}=96.5$ 29 %, to the 0 <sup>+</sup> g.s.; and, b) $E(\alpha)=5289.8$ keV, $I_{\alpha}=3.5$ 4 %, to the 2 <sup>+</sup> level ( <b>2000Ko16</b> ). A reduced $\alpha$ width $\delta^2=155+17-20$ keV for the 5447 keV $\alpha$ transition was deduced by <b>2000Ko16</b> .
170.30 <sup>@</sup> 10	2 <sup>+</sup>		
427.40 <sup>@</sup> 15	4 <sup>+</sup>	37.5 ps 32	
765.16 <sup>@</sup> 18	6 <sup>+</sup>	10.9 ps 8	
1178.33 <sup>@</sup> 20	8 <sup>+</sup>	3.7 ps 4	$T_{1/2}$ : Value uncertain due to contaminants in the spectrum ( <b>1986Dr05</b> ).
1345.7 5			
1573.5 <sup>&amp;</sup> 3	5 <sup>-</sup>		
1661.32 <sup>@</sup> 22	10 <sup>+</sup>		
1810.0 <sup>a</sup> 4	(6 <sup>-</sup> )		
1814.3 <sup>&amp;</sup> 3	7 <sup>-</sup>		$B(E1,636.3)/B(E2,241.5)=9.2$ 20 $10^{-7}$ b <sup>-1</sup> , and $B(E1,1047.9)/B(E2,241.5)=0.38$ 11 $10^{-7}$ b <sup>-1</sup> ( <b>2000Ko16</b> ).
2029.7 5			
2118.8 <sup>a</sup> 4	(8 <sup>-</sup> )		$B(E1,940.4)/B(E2,308.8)=5.5$ 12 $10^{-7}$ b <sup>-1</sup> ( <b>2000Ko16</b> ).
2137.6 <sup>&amp;</sup> 4	9 <sup>-</sup>		$B(E1,476.4)/B(E2,323.1)=13.6$ 29 $10^{-7}$ b <sup>-1</sup> ( <b>2000Ko16</b> ).
2209.02 <sup>@</sup> 24	12 <sup>+</sup>		
2495.9 <sup>a</sup> 4	(10 <sup>-</sup> )		$B(E1,834.6)/B(E2,377.1)=2.1$ 9 $10^{-7}$ b <sup>-1</sup> ( <b>2000Ko16</b> ).
2534.3 <sup>&amp;</sup> 4	11 <sup>-</sup>		
2813.6 <sup>@</sup> 3	14 <sup>+</sup>		
2925.1 <sup>a</sup> 6	(12 <sup>-</sup> )		
2996.0 <sup>&amp;</sup> 6	13 <sup>-</sup>		
3408.0 <sup>a</sup> 7	(14 <sup>-</sup> )		
3459.2 <sup>@</sup> 3	16 <sup>+</sup>		
3514.5 <sup>&amp;</sup> 7	15 <sup>-</sup>		
4077.2 <sup>&amp;</sup> 8	(17 <sup>-</sup> )		
4110.1 <sup>@</sup> 5	(18 <sup>+</sup> )		
4664.9 <sup>&amp;</sup> 9	(19 <sup>-</sup> )		
4753.7 <sup>@</sup> 10	(20 <sup>+</sup> )		
5282.5 <sup>&amp;</sup> 12	(21 <sup>-</sup> )		
5430.4 <sup>@</sup> 13	(22 <sup>+</sup> )		
5928.1 <sup>&amp;</sup> 15	(23 <sup>-</sup> )		
6159.4 <sup>?</sup> @	(24 <sup>+</sup> )		
6601.2 <sup>?</sup> &	(25 <sup>-</sup> )		

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(HI,xn $\gamma$ ) **2000Ko16,1999So01,1986Dr05 (continued)**

$^{178}\text{Pt}$  Levels (continued)

† From least-squares fit by evaluators to  $E\gamma$ 's from [2000Ko16](#).

‡ Spin and parity assignments are based mainly on angular distributions and anisotropy information ([2000Ko16](#)).

# From [1986Dr05](#) unless otherwise indicated.

@ Band(A): Band 1 Ground-state band. From [1986Dr05](#) and [1999So01](#) up to the  $18^+$  level; extended to  $22^+$  (tentatively  $24^+$ ) in [2000Ko16](#). The perturbed low-spin structure observed in this yrast band has been attributed to the coexistence of two shapes ([1986Dr05](#)).

& Band(B): Band 2 Odd spin, negative parity band. Established by [1999So01](#) up to  $17^-$  level; extended to  $23^-$  (tentatively  $25^-$ ) in [2000Ko16](#). The level sequence of this band may be interpreted as a decoupled two-quasiparticle  $\pi h_{9/2}$  rotational band with an admixture of octupole vibrations at low spin ([1999So01](#)). This view has also been adopted in [2000Ko16](#).

<sup>a</sup> Band(C): Band 3 Even spin, negative parity band. This band is established by [2000Ko16](#). The configuration of these states is interpreted as octupole vibrations at low spin, which are crossed at higher frequency by two-quasiparticle excitations. The latter are considered to be most likely neutron excitations.

$\gamma(^{178}\text{Pt})$

Ratio R (angular anisotropy coefficient) defined as the ratio of the  $\gamma$  intensity seen by the Gammasphere detector rings at  $\approx 35^\circ$  and  $\approx 145^\circ$  with respect to that at  $\approx 90^\circ$  ([2000Ko16](#)).

$E_\gamma$ †	$I_\gamma$ #	$E_i(\text{level})$	$J_i^\pi$	$E_f$	$J_f^\pi$	Mult. ‡	$\alpha$ @	Comments
170.3 1	73 3	170.30	$2^+$	0.0	$0^+$	E2	0.630	Mult.: R=1.2 1; $A_2=+0.20$ 4, $A_4=+0.08$ 5. $\alpha$ : $\alpha_{\text{tot}}(\text{exp})=0.65$ 5 from the intensity balance at the $2^+$ level ( <a href="#">2000Ko16</a> ). From theory: $\alpha_{\text{tot}}(\text{M1})=1.465$ , $\alpha_{\text{tot}}(\text{E2})=0.630$ , $\alpha_{\text{tot}}(\text{E1})=0.105$ .
241.5 4	2.0 4	1814.3	$7^-$	1573.5	$5^-$	E2	0.193	Mult.: R=1.2 2.
257.1 1	100 4	427.40	$4^+$	170.30	$2^+$	E2	0.1578	B(E2)(W.u.)=195 17 B(E2)=1.16 10 $e^2b^2$ ( <a href="#">1986Dr05</a> ). $Q_t=6.4$ 3 eb ( <a href="#">1986Dr05</a> ).
308.8 4	2.4 4	2118.8	$(8^-)$	1810.0	$(6^-)$	E2	0.0904	Mult.: R=1.2 1; $A_2=+0.12$ 4, $A_4=-0.03$ 5.
323.1 4	9.8 13	2137.6	$9^-$	1814.3	$7^-$	E2	0.0792	Mult.: R=1.1 2.
337.7 1	92 5	765.16	$6^+$	427.40	$4^+$	E2	0.0698	Mult.: R=1.3 1; $A_2=+0.21$ 12, $A_4=-0.03$ 14. B(E2)(W.u.)=186 14 B(E2)=0.96 7 $e^2b^2$ ( <a href="#">1986Dr05</a> ). $Q_t=5.5$ 2 eb ( <a href="#">1986Dr05</a> ).
377.1 4	4.8 7	2495.9	$(10^-)$	2118.8	$(8^-)$	E2	0.0513	Mult.: R=1.1 1; $A_2=+0.12$ 6, $A_4=+0.03$ 7.
396.7 1	10.1 12	2534.3	$11^-$	2137.6	$9^-$	E2	0.0447	Mult.: R=1.3 2. $I_\gamma$ : contaminated by a strong 396.6 line from $^{178}\text{Hg}$ .
413.2 1	71 7	1178.33	$8^+$	765.16	$6^+$	E2	0.0401	Mult.: R=1.2 2; $A_2=+0.16$ 4, $A_4=-0.06$ 6. B(E2)(W.u.)=205 23 Mult.: R=1.4 1; $A_2=+0.36$ 5, $A_4=+0.13$ 5. $Q_t=6.1$ 3 eb ( <a href="#">1986Dr05</a> ).
429.2 4	4.0 8	2925.1	$(12^-)$	2495.9	$(10^-)$	E2	0.0364	Mult.: R=1.3 2.
461.7 4	9.2 20	2996.0	$13^-$	2534.3	$11^-$	E2	0.0302	Mult.: R=1.4 2, $A_2=+0.30$ 11, $A_4=-0.10$ 12.
476.4 4	5.3 9	2137.6	$9^-$	1661.32	$10^+$	(E1)	0.00916	B(E1)=8.8 21 $10^{-5}$ W.u., deduced by <a href="#">2000Ko16</a> from their experimental ratio $B(\text{E1},476.4)/B(\text{E2},323.1)=13.6$ 29 $10^{-7}$ $b^{-1}$ , and a calculated B(E2,323.1) assuming $Q_0=6.4$ 3 eb from <a href="#">1986Dr05</a> .
483.0 1	47.1 35	1661.32	$10^+$	1178.33	$8^+$	E2	0.0270	Mult.: R=1.1 1; $A_2=+0.12$ 6, $A_4=+0.03$ 7.
483 & 1	<1	3408.0?	$(14^-)$	2925.1	$(12^-)$	(E2)	0.0270	
518.5 4	6.9 16	3514.5	$15^-$	2996.0	$13^-$	E2	0.0227	Mult.: R=1.4 2.

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**(HI,xn $\gamma$ ) 2000Ko16,1999So01,1986Dr05 (continued)** $\gamma(^{178}\text{Pt})$  (continued)

$E_\gamma^\dagger$	$I_\gamma^\#$	$E_i(\text{level})$	$J_i^\pi$	$E_f$	$J_f^\pi$	Mult. $^\ddagger$	$\alpha^\@$	Comments
547.7 1	30 3	2209.02	12 <sup>+</sup>	1661.32	10 <sup>+</sup>	E2	0.0199	Mult.: R=1.4 1; A <sub>2</sub> =+0.30 6, A <sub>4</sub> =+0.02 7.
562.7 4	4.0 8	4077.2	(17 <sup>-</sup> )	3514.5	15 <sup>-</sup>	(E2)	0.0187	
587.7 4	2.3 5	4664.9	(19 <sup>-</sup> )	4077.2	(17 <sup>-</sup> )	E2	0.01688	Mult.: R=1.4 3.
604.6 1	16.1 25	2813.6	14 <sup>+</sup>	2209.02	12 <sup>+</sup>	E2	0.01582	Mult.: R=1.2 2; A <sub>2</sub> =+0.23 11, A <sub>4</sub> =-0.12 12.
617.6 8	<1	5282.5	(21 <sup>-</sup> )	4664.9	(19 <sup>-</sup> )	(E2)	0.01507	
636.3 4	7.5 7	1814.3	7 <sup>-</sup>	1178.33	8 <sup>+</sup>	E1	0.00502	B(E1)=5.7 14 10 <sup>-5</sup> W.u., deduced by 2000Ko16 from their experimental ratio B(E1,636.3)/B(E2,241.5)=9.2 20 10 <sup>-7</sup> b <sup>-1</sup> , and a calculated B(E2,241.5) assuming Q <sub>0</sub> =6.4 3 eb from 1986Dr05. Mult.: R=0.6 1; A <sub>2</sub> =-0.17 9, A <sub>4</sub> =+0.07 12.
643.6 8	<1	4753.7	(20 <sup>+</sup> )	4110.1	(18 <sup>+</sup> )	(E2)	0.01374	
645.6 1	10.7 20	3459.2	16 <sup>+</sup>	2813.6	14 <sup>+</sup>	E2	0.01365	Mult.: R=1.1 2; A <sub>2</sub> =+0.24 8, A <sub>4</sub> =+0.04 10.
645.6 8	<1	5928.1	(23 <sup>-</sup> )	5282.5	(21 <sup>-</sup> )	(E2)	0.01365	
650.9 4	4.0 6	4110.1	(18 <sup>+</sup> )	3459.2	16 <sup>+</sup>	(E2)	0.01340	
673& 1	<1	6601.2?	(25 <sup>-</sup> )	5928.1	(23 <sup>-</sup> )	(E2)	0.01242	
676.7 8	<1	5430.4	(22 <sup>+</sup> )	4753.7	(20 <sup>+</sup> )	(E2)	0.01230	
729& 1	<1	6159.4?	(24 <sup>+</sup> )	5430.4	(22 <sup>+</sup> )	(E2)	0.01047	
808.0 4	2.4 4	1573.5	5 <sup>-</sup>	765.16	6 <sup>+</sup>	(E1)	0.00315	
834.6 4	1.0 4	2495.9	(10 <sup>-</sup> )	1661.32	10 <sup>+</sup>	(E1)	0.00296	2000Ko16 list this transition as (E2). This misprint is inconsistent with the J <sup><math>\pi</math></sup> change between the initial and final states in their proposed level scheme. B(E1)=1.4 6 10 <sup>-5</sup> W.u., deduced by 2000Ko16 from their experimental ratio B(E1,834.6)/B(E2,377.1)=2.1 9 10 <sup>-7</sup> b <sup>-1</sup> , and a calculated B(E2,377.1) assuming Q <sub>0</sub> =6.4 3 eb from 1986Dr05.
918.3 4	4.2 8	1345.7		427.40	4 <sup>+</sup>			
940.4 4	5.1 7	2118.8	(8 <sup>-</sup> )	1178.33	8 <sup>+</sup>	(E1)	0.00237	B(E1)=3.5 8 10 <sup>-5</sup> W.u., deduced by 2000Ko16 from their experimental ratio B(E1,940.4)/B(E2,308.8)=5.5 12 10 <sup>-7</sup> b <sup>-1</sup> , and a calculated B(E2,308.8) assuming Q <sub>0</sub> =6.4 3 eb from 1986Dr05.
1044.8 4	4.3 8	1810.0	(6 <sup>-</sup> )	765.16	6 <sup>+</sup>	(E1)	0.00196	
1047.9 4	1.4 3	1814.3	7 <sup>-</sup>	765.16	6 <sup>+</sup>	(E1)	0.00195	B(E1)=0.24 7 10 <sup>-5</sup> W.u., deduced by 2000Ko16 from their experimental ratio B(E1,1047.9)/B(E2,241.5)=0.38 11 10 <sup>-7</sup> b <sup>-1</sup> , and a calculated B(E2,241.5) assuming Q <sub>0</sub> =6.4 3 eb from 1986Dr05.
1147.1 4	1.8 3	1573.5	5 <sup>-</sup>	427.40	4 <sup>+</sup>	(E1)	1.66 $\times$ 10 <sup>-3</sup>	
1264.5 4	3.9 9	2029.7		765.16	6 <sup>+</sup>			

$^\dagger$  From 2000Ko16. Uncertainties assigned by evaluators, based on estimates by 2000Ko16:  $\Delta(E_\gamma)=0.8$  for  $I_\gamma<1$ ,  $\Delta(E_\gamma)=0.4$  for  $1\geq I_\gamma\leq 10$  and  $\Delta(E_\gamma)=0.1$  for  $I_\gamma>10$ .

$^\ddagger$  From  $\gamma$ -ray angular distributions and anisotropy ratios (2000Ko16).

$^\#$  Deduced from the total projection of the recoil- $\gamma$ - $\gamma$  matrix and coincidence projections after appropriate normalization (2000Ko16).

$^\@$  Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation

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(HI,xn $\gamma$ ) 2000Ko16,1999So01,1986Dr05 (continued)

$\gamma(^{178}\text{Pt})$  (continued)

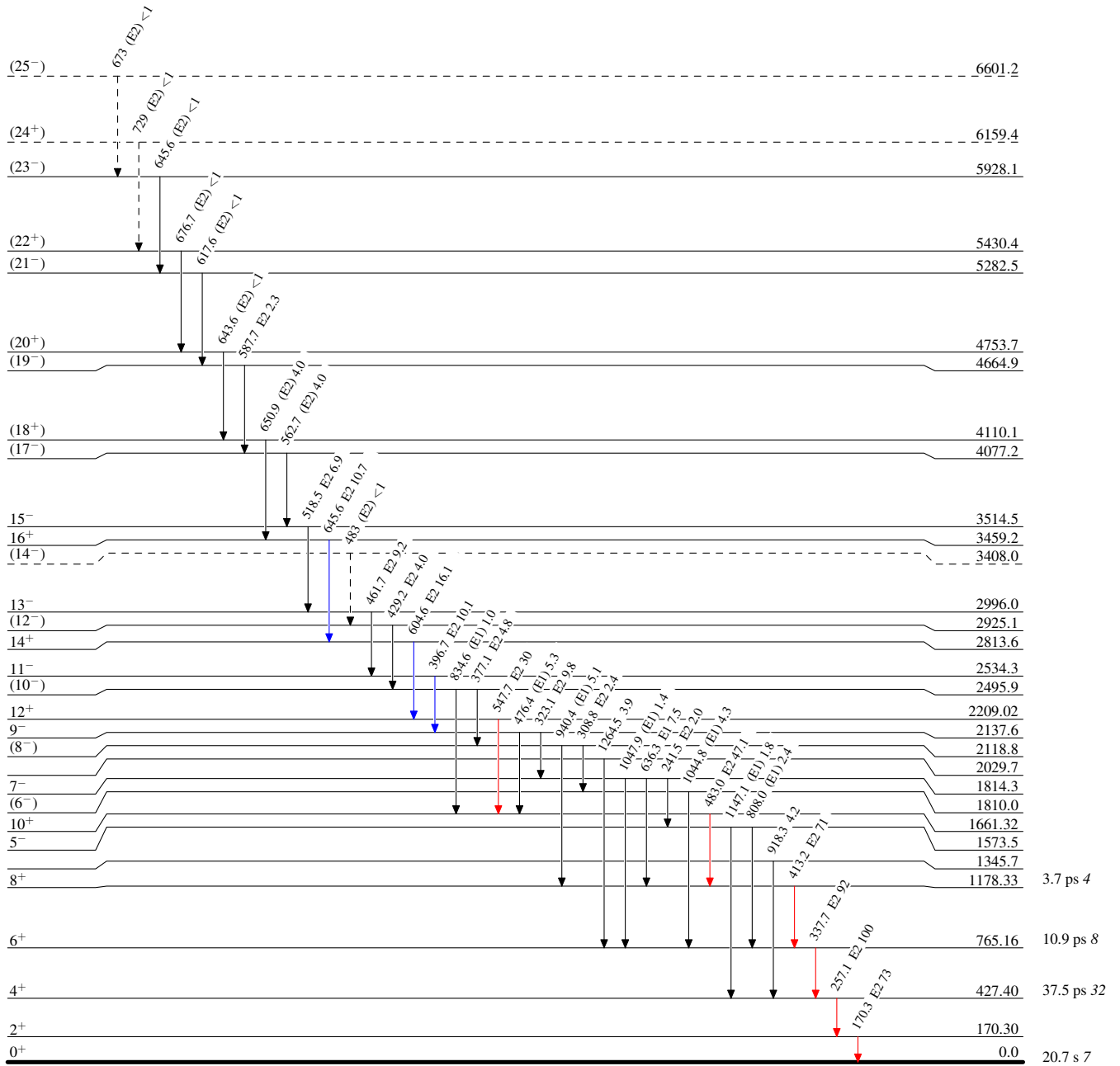
based on  $\gamma$ -ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.  
& Placement of transition in the level scheme is uncertain.

**(HI,xn $\gamma$ ) 2000Ko16,1999So01,1986Dr05**

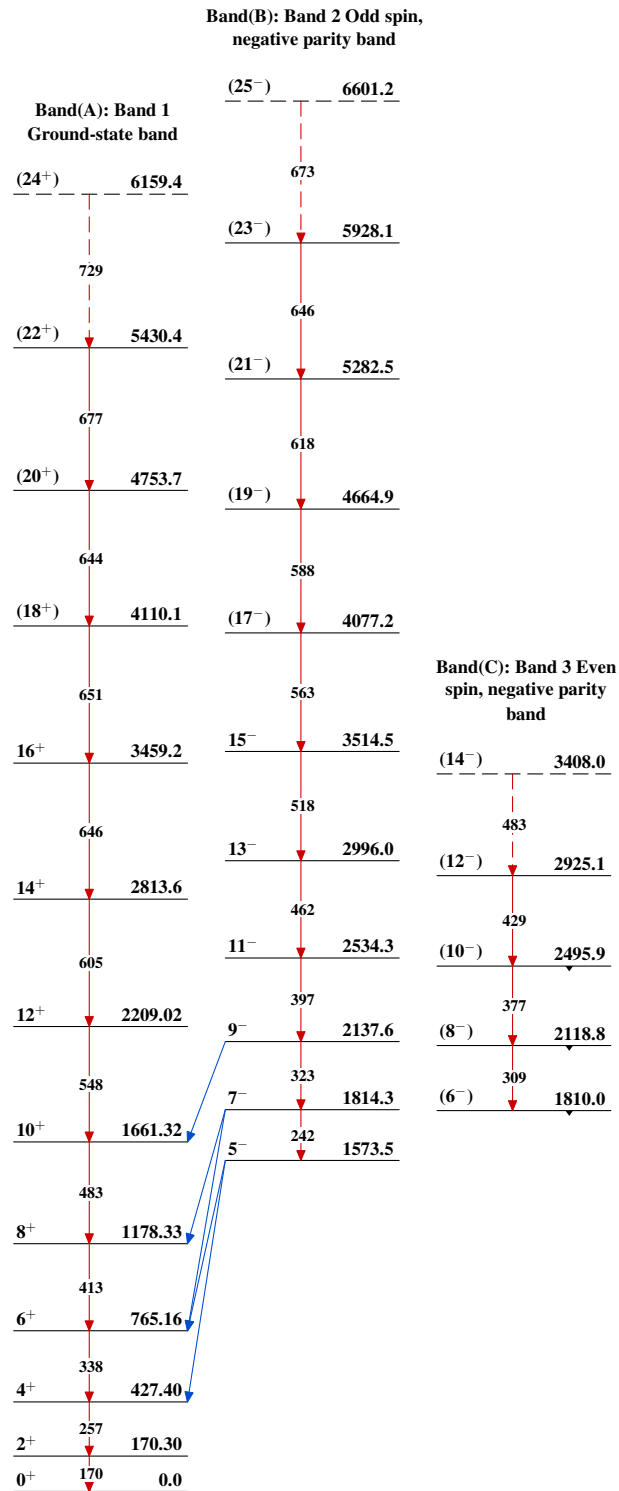
Legend

**Level Scheme**  
Intensities: Relative  $I_\gamma$

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



$^{178}_{78}\text{Pt}_{100}$

**(HI,xn $\gamma$ ) 2000Ko16,1999So01,1986Dr05** $^{178}_{78}\text{Pt}_{100}$