

Adopted Levels, Gammas

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	M. S. Basunia	NDS 181, 475 (2022)	1-Jan-2022

$Q(\beta^-)=1422$ 6; $S(n)=5185$ 5; $S(p)=4972$ 5; $Q(\alpha)=5988$ 3 [2021Wa16](#)

Other studies:

[1984Es01](#): $^{208}\text{Pb}(^{18}\text{O},X)$, $E\approx 80\text{--}180$ MeV; measured residuals absolute production $\sigma(E)$.

[2020De36](#): $^{238}\text{U}(^{48}\text{Ca},X)$, $E=233.3$ MeV; measured multi-nucleon transfer reaction cross section $\sigma_{\text{cumulative}}=2031$ nb/sr 8 for ^{213}Bi production.

 ^{213}Bi LevelsCross Reference (XREF) Flags

- A** ^{213}Pb β^- decay (10.2 min)
B ^{217}At α decay
C $^9\text{Be}(^{238}\text{U},X)$

E(level) [†]	J^π	$T_{1/2}$	XREF	Comments
0.0	$9/2^-$	45.59 min 6	ABC	$\% \alpha = 2.140$ 10; $\% \beta^- = 97.860$ 10 $\mu = +3.699$ 7 $Q = -0.83$ 5 Isotope shift: $\delta \langle r^2 \rangle (^{213}\text{Bi}, ^{209}\text{Bi}) = 0.422$ fm ² 29 (2018Ba03). Other: 0.416 fm ² 1 (2013An02). J^π : Based on favored α decay of $^{217}\text{At}(J^\pi=9/2^-) \rightarrow$ to ^{213}Bi g.s.. $J^\pi(^{217}\text{At})=9/2^-$ based on $^{221}\text{Fr}(J^\pi=5/2^-) \alpha$ decay $\rightarrow$ 218 level ($J^\pi=5/2^-$) and $\rightarrow$ E2 γ to g.s. of ^{217}At (1972Dz14 , 1977Vy02). Also supported by the HFS and μ measurements (2019Ba22). $T_{1/2}$: Weighted average of 45.59 min 6 (1973Po16), 47 min 1 (1950Ha52), 46 min 1 (1964Gr11), 45.636 min 220 and 45.598 min 91 from Cherenkov counting and $\gamma(t)$, respectively (2021Ta01), 45.62 min 6 (2013Su13 , 2013Ma13 – from beta decay curve). Others: 46 min (1947En03). $\% \alpha = 2.140$ 10 from 2013Ma13 and $\% \beta^- = 100 - \% \alpha$. Others: $\% \alpha = 2.09$ 3 (1998Ar03), $\% \alpha = 2.20$ 3 (1997Ch53), $\% \alpha = 2.16$ 11 (1964Gr11), $\% \alpha = 2.0$ (1950Ha52), $\% \alpha = 2$ (1947En03), and $\% \alpha = 2.022$ 26 (1986He06 based on 465 γ of ^{209}Tl). Weighted average of all values, with uncertainty, excluding the 1986He06 value yields $\% \alpha = 2.140$ 14. μ : From 2019StZV (based on +3.716 7 in 1997Ki15 , 2000Pe30 , 2000Bi23 (laser spectroscopy)). Others: +3.89 9 (1992Li25 – from $\gamma(\theta, t)$), the value 3.672 7 in 2018Ba03 appears to be quoted from 1992Li25 as of Fig. 7, however the reason of the difference is not clear. Q : From 2016St14 , 2001Bi23 (reference value -0.516 15 ^{209}Bi). Others: -0.60 5 (1997Ki15 , 2000Pe30 – reference value -0.370 26 (^{209}Bi)). -0.68 5 (2018Ba03 – not clear if it is their measured value or not). Configuration: $\pi(h_{9/2}^{+1})$. J^π : 257.9 γ M1+E2 to $9/2^-$ state. Unfavored α decay (HF=394) from ^{217}At g.s. ($J^\pi=9/2^-$). J^π : 593.1 γ to $9/2^-$ state, 335.3 γ to $7/2^-$ state. J^π : 758.9 γ to $9/2^-$ state.
257.86 4	$7/2^-$		AB	
593.13 3	$(5/2, 7/2, 9/2)^-$		AB	
758.90 10	$(5/2^-, 13/2^-)$		B	
874.3 5			A	
977.80 14			A	
982.89 10			A	
1050			B	E(level): From 6037 α feeding from ^{217}At .
1142.42 9			A	
1149.34 10			A	

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

 ^{213}Bi Levels (continued)

E(level) [†]	XREF	Comments
1171.01 10	A	
1202.14? 12	A	
1222.34? 12	A	
1287.24? 12	A	
1295.55 11	A	
1343.1? 3	A	
1353 21	C	E(level): Isomer ($^{238}\text{U,X}$) was identified from Schottky frequency spectrum (figure 2 in 2012Ch19).
1445.14 10	A	
1495.26 11	A	
1543.37 11	A	
1592.74 22	A	

[†] From least-square fit to $E\gamma$. Uncertainties of 720.3γ and 977.5γ from 977.7 keV level, 1187.0γ and 1335.5γ from 1445 were doubled, 1445.4γ and 1592.1γ from 1592 keV level were tripled for the fit. Critical $\chi^2=2.0$, otherwise the reduced $\chi^2=7.8$:

Adopted Levels, Gammas (continued)

$E_i(\text{level})$	J_i^π	$\gamma(^{213}\text{Bi})$							Comments
		$E_\gamma^\dagger$	$I_\gamma^\dagger$	E_f	J_f^π	Mult.	δ	$\alpha^\#$	
257.86	$7/2^-$	257.89 6	100	0.0	$9/2^-$	M1+E2	0.59 13	0.57 5	$\alpha(\text{K})=0.45$ 4; $\alpha(\text{L})=0.093$ 3; $\alpha(\text{M})=0.0223$ 5 $\alpha(\text{N})=0.00569$ 13; $\alpha(\text{O})=0.00114$ 3; $\alpha(\text{P})=0.000128$ 6 Mult.: M1+E2 from $\alpha(\text{K})\text{exp}=0.45$ 4 (^{217}At α decay), $\alpha(\text{K})\text{exp}=0.56$ 4 (^{213}Pb β^- decay). M1 in 1969LeZW from $(\alpha)(\text{K x ray})/(\alpha)(\gamma)$ coincidence. δ : Deduced by the evaluator from $\alpha(\text{K})\text{exp}=0.45$ 4. I_γ : Other: 80 13 (^{213}Pb β^- decay).
593.13	$(5/2, 7/2, 9/2)^-$	335.26 5	54 3	257.86	$7/2^-$				
		593.13 3	100 4	0.0	$9/2^-$				
758.90	$(5/2^-, 13/2^-)$	758.9 1	100	0.0	$9/2^-$				
874.3		874.3 $\dagger$ 10	100	0.0	$9/2^-$				
977.80		103.5 $\dagger$ 5		874.3					
		720.3 $\dagger$ 1	56 $\dagger$ 7	257.86	$7/2^-$				
		977.5 $\dagger$ 1	100 $\dagger$ 13	0.0	$9/2^-$				
982.89		389.8 $\dagger$ 5		593.13	$(5/2, 7/2, 9/2)^-$				
		982.9 $\dagger$ 1	100 $\dagger$ 13	0.0	$9/2^-$				
1142.42		1142.4 $\dagger$ 1	100	0.0	$9/2^-$				
1149.34		893.1 $\dagger$ 10	99 $\dagger$ 14	257.86	$7/2^-$				
		1149.3 $\dagger$ 1	100 $\dagger$ 14	0.0	$9/2^-$				
1171.01		913.8 $\dagger$ 10	5 $\dagger$ 1	257.86	$7/2^-$				
		1171.0 $\dagger$ 1	100 $\dagger$ 13	0.0	$9/2^-$				
1202.14?		944.5 $\dagger$ @ 1	100	257.86	$7/2^-$				
1222.34?		964.7 $\dagger$ @ 1	100	257.86	$7/2^-$				
1287.24?		1029.6 $\dagger$ @ 1	100	257.86	$7/2^-$				
1295.55		1037.7 $\dagger$ 1	100	257.86	$7/2^-$				
1343.1?		1085.5 $\dagger$ @ 3	100	257.86	$7/2^-$				
1445.14		274.3 $\dagger$ @ 5	10 $\dagger$ 5	1171.01					
		295.4 $\dagger$ 5		1149.34					
		302.7 $\dagger$ 1	30 $\dagger$ 4	1142.42					
		462.7 $\dagger$ 5		982.89					
		467.8 $\dagger$ 5		977.80					
		1187.0 $\dagger$ 1	100 $\dagger$ 15	257.86	$7/2^-$				
		1445.4 $\dagger$ 1	18 $\dagger$ 3	0.0	$9/2^-$				
1495.26		324.2 $\dagger$ @ 1	100 $\dagger$ 13	1171.01					
		1237.4 $\dagger$ 1	86 $\dagger$ 12	257.86	$7/2^-$				
1543.37		248.0 $\dagger$ 5		1295.55					
		565.5 $\dagger$ 5		977.80					

Adopted Levels, Gammas (continued)

$\gamma(^{213}\text{Bi})$ (continued)

<u>E_i(level)</u>	<u>J^{π}_i</u>	<u>E_{γ}[†]</u>	<u>I_{γ}[†]</u>	<u>E_f</u>	<u>J^{π}_f</u>
1543.37		1285.5 [‡] 1	100 [‡] 15	257.86	7/2 ⁻
1592.74		1335.5 [‡] 1	49 [‡] 14	257.86	7/2 ⁻
		1592.1 [‡] 1	100 [‡] 14	0.0	9/2 ⁻

† From ²¹⁷At α decay, except otherwise noted.
‡ From ²¹³Pb β - decay (10.2 m).
[Additional information 1.](#)
@ Placement of transition in the level scheme is uncertain.

