^{209}Bi(p,p′) 1975Wa03,1974Cl07,1974Cl06

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	J. Chen # and F. G. Kondev	NDS 126, 373 (2015)	30-Sep-2013

Target $J^\pi(^{209}Bi)=9/2^-$.

1975Wa03: E=35 MeV proton beam was produced from the Michigan State University cyclotron. Thick bismuth targets were used. Scattered protons were momentum analyzed by an Enge split-pole spectrometer and detected in the focal plane detectors, FWHM=5-10 keV, θ=10° to 100°. Measured $\sigma(\theta)$. Deduced levels, L, β_L from DWBA analysis.

1974Cl07: E=14.95, 16.10 MeV proton beams were produced from the Yale MP tandem Van de Graaff. A self-supporting 185 μg/cm^2 target was used. Scattered protons were momentum analyzed by a multi-gap magnetic spectrograph and detected in nuclear emulsions, FWHM=5-7 keV. Measured $\sigma(\theta)$. Deduced levels, L, β_L from DWBA analysis. See also 1974Cl06.

1974Cl06: E=14.0-15.5 MeV proton beams were produced from the Yale MP tandem Van de Graaff. A self-supporting 350 μg/cm^2 target was used. Scattered protons were detected by silicon surface-barrier detectors, FWHM=15 keV, θ=90°. Measured $\sigma(\theta)$. Deduced levels, J^π.

1974Sc20: E=61.2 MeV proton beam was produced form the Oak Ridge Isochronous Cyclotron. A 12 mg/cm^2 target was used. Scattered protons were momentum analyzed with a broad-range spectrograph and detected in nuclear emulsions, FWHM=40-55 keV. Measured $\sigma(\theta)$. Deduced levels, β_L from collective model analysis.

1966Ha35: E=21 MeV proton beam was produced from the LASL three-stage Van de Graaff accelerator. Scattered protons were momentum analyzed with an Elbek magnetic spectrograph, FWHM=13 keV. Measured $\sigma(\theta)$. Deduced levels.

Others: 1985Se15, 1972Cl02, 1972Co05, 1971Be32, 1970Be15, 1970Fr08.

Data of 1974Cl07 and 1974Cl06 at 14.95 preferentially populate states of ^{209}Bi through decay of the isobaric analogs of states in ^{210}Bi. Based on this proton resonant and the non-resonant scattering data, 1974Cl06 suggest configurations of the type configuration=(^{208}Pb(j′))(p,nlj")J for many of the states seen in (p,p′). See also 1972Cl02, 1972Co05.

^{209}Bi Levels

E(level)[†]	L[b]	β_L[e]	Comments
0.0			
895.9[‡]	(2)	0.013	L: 4+6 from 1974Sc20. $\sigma(\theta)$ could not be fit with the collective model assuming L=2 transfer. β_4=0.0125, β_6=0.0134 (1974Sc20).
1608.1[‡]	3	0.0230 *13*	B(E3)↑=2.7×10^{-2} *3* (1974Sc20) β_L: from 1974Sc20, 0.027 from 1975Wa03. Others: ≈0.024 (1971Be32), 0.022 (1970Be15). configuration=$\pi(1h_{9/2})^{+1}\otimes 3^-$ (1974Cl07).
2492[a] *1*	3	0.026	Additional information 1. configuration=$\pi(1h_{9/2})^{+1}\otimes 3^-$ (1974Cl07).
2564[a] *1*	3	0.047	Additional information 2. configuration=$\pi(1h_{9/2})^{+1}\otimes 3^-$ (1974Cl07).
2581[a] *2*	3	0.041	Additional information 3. configuration=$\pi(1h_{9/2})^{+1}\otimes 3^-$ (1974Cl07).
2599[a] *1*	3	0.074	Additional information 4. configuration=$\pi(1h_{9/2})^{+1}\otimes 3^-$ (1974Cl07).
2616[a] *2*	3	0.035	B(E3)↑=0.50 *5* (1974Sc20) Additional information 5. β_L: Others: 0.11 *1* (1971Be32) and 0.099 *5* (1974Sc20) for a level at E=2650 *30*. configuration=$\pi(1h_{9/2})^{+1}\otimes 3^-$ (1974Cl07).
2740.4[‡]	3	0.057	E(level): 2739 *3* (1966Ha35). Additional information 6. configuration=$\pi(1h_{9/2})^{+1}\otimes 3^-$ (1974Cl07).
2766 *2*	(5)		Additional information 7. L: L=4 (1975Wa03), L=5 (1974Cl07). β_L: 0.013 for L=4. configuration=$\pi(1h_{9/2})^{+1}\otimes 5^-_1$ (1974Cl07).
2825.1[‡]	2[c]		E(level): 2826 *4* (1974Cl07).

Continued on next page (footnotes at end of table)

^{209}Bi(p,p′) 1975Wa03,1974Cl07,1974Cl06 (continued)

^{209}Bi Levels (continued)

E(level)[†]	L[b]	β_L[e]	Comments
			configuration=$\pi(1h_{9/2})^{+1}\otimes 2^+$ (1974Cl07).
2847[#] *4*			configuration=$\pi(1h_{9/2})^{+1}\otimes 5^-_1$ (1974Cl07).
2919[#] *4*			configuration=$\pi(1h_{9/2})^{+1}\otimes 4^-$ (1974Cl07).
2956 *3*	3		Additional information 8. L: L=(4) (1975Wa03), L=3 (1974Cl07). β_L: 0.014 for L=4. configuration=$\pi(1h_{9/2})^{+1}\otimes 3^-$ (1974Cl07).
2986 *1*	5	0.021	Additional information 9. configuration=$\pi(1h_{9/2})^{+1}\otimes 5^-_1$ or $\pi(1h_{9/2})^{+1}\otimes 5^-_2$ (1974Cl07).
3038 *2*	5	0.013	Additional information 10. configuration=$\pi(1h_{9/2})^{+1}\otimes 5^-$ (1974Cl07).
3091 *3*	5	0.014	3091 *3* (1975Wa03), 3091 *4* (1974Cl07).
3118 *2*			
3133.9[‡]	5	0.036	E(level): 3135 *4* (1974Cl07). configuration=$\pi(1h_{9/2})^{+1}\otimes 5^-_1$ (1974Cl07).
3153.4[‡]	5	0.032	E(level): Probable doublet, based on σ and on the observation that the excitation function appears to resonate at both the J^π=8$^-$,9$^-$ and J^π=4$^-$,5$^-$ isobaric analog resonances. 1974Cl07 report 3154 *4*. β_L: 0.050 *5* from 1971Be32 for a level at E=3150 *30*. configuration=$\pi(1h_{9/2})^{+1}\otimes 5^-_1$ or $\pi(1h_{9/2})^{+1}\otimes 4^-$ (1974Cl07).
3168 *2*	5	0.026	Additional information 11. configuration=$\pi(1h_{9/2})^{+1}\otimes 5^-_1$ (1974Cl07).
3211 *1*	5	0.020	Additional information 12. configuration=$\pi(1h_{9/2})^{+1}\otimes 4^-$ or $\pi(1h_{9/2})^{+1}\otimes 5^-_1$ (1974Cl07).
3222[#] *4*			configuration=$\pi(1h_{9/2})^{+1}\otimes 4^-$ (1974Cl07).
3310 *3*	(3)	0.009	Additional information 13. configuration=$\pi(1h_{9/2})^{+1}\otimes 4^-$ (1974Cl07).
3359 *2*			Additional information 14.
3379[#] *4*			
3393[#] *4*			
3406[#] *4*			configuration=$\pi(1h_{9/2})^{+1}\otimes 4^-$ (1974Cl07).
3450[#] *4*			configuration=$\pi(1h_{9/2})^{+1}\otimes 4^-$ (1974Cl07).
3466[&] *2*	5	0.019	E(level): 3465 *4* (1974Cl07). configuration=$\pi(1h_{9/2})^{+1}\otimes 4^-$ (1974Cl07).
3489[#] *4*			
3502 *4*			Additional information 15. configuration=$\pi(1h_{9/2})^{+1}\otimes 4^-$ (1974Cl07).
3543[#] *4*			
3579 *3*	5	0.012	Additional information 16. β_L: 0.029 *4* from 1971Be32 for a level at E=3560 *50*.
3597[&] *2*	5	0.020	E(level): 3597 *4* (1974Cl07). configuration=$\pi(1h_{9/2})^{+1}\otimes 5^-_2$ or $\pi(1h_{9/2})^{+1}\otimes 5^-_1$ (1974Cl07).
3603[#] *5*			
3634 *4*			Additional information 17. configuration=$\pi(1p_{1/2})^{+1}$ (1974Cl07).
3684 *3*	5	0.015	Additional information 18.
3692[#] *5*			configuration=$\pi(1h_{11/2})^{-1}$ (1974Cl07).
3703[@] *4*	5	0.015	
3719[#] *5*			
3735[#] *5*			
3753[#] *5*			

Continued on next page (footnotes at end of table)

^{209}Bi(p,p′) 1975Wa03,1974Cl07,1974Cl06 (continued)

^{209}Bi Levels (continued)

E(level)[†]	L[b]	β_L[e]	Comments
3765[&] *3*			E(level): 3763 *5* (1974Cl07).
3803 *4*	(3)	0.013	Additional information 19.
3815 *2*	(7,8)	0.031,0.026	Additional information 20.
3839[&] *4*			E(level): 3839 *5* (1974Cl07).
3855 *3*			Additional information 21.
3880[#] *5*			
3892 *3*			Additional information 22.
3909[#] *5*			
3924[&] *5*	(3)	0.013	E(level): 3919 *5* (1974Cl07).
3937[#] *5*			
3950[#] *5*	(3)	0.012	
3962[#] *5*			
3982 *3*	2	0.033	Additional information 23. β_L: 0.049 *7* from 1971Be32 for a level at E=3960 *50*. configuration=$\pi(1h_{9/2})^{+1}\otimes 2^+$ (1974Cl07).
3998[#] *5*			
4013 *5*			Additional information 24.
4038[#] *7*			
4048 *5*			Additional information 25.
4079[#] *7*			
4092 *4*	2	0.027	Additional information 26. configuration=$\pi(1h_{9/2})^{+1}\otimes 2^+$ or $\pi(2f_{5/2})^{+1}$ (1974Cl07).
4101[#] *7*			
4116 *4*	(7)	0.022	Additional information 27.
4123[#] *7*			
4135[#] *7*			
4156 *4*	2	0.027	Additional information 28.
4162[#] *7*	*d*		configuration=$\pi(1h_{9/2})^{+1}\otimes 2^+$ (1974Cl07).
4168[#] *7*	*d*		
4178 *4*	3	0.033	Additional information 29.
4211 *4*			Additional information 30. L: L=2 (1974Cl07), L=3 (1975Wa03). β_L: 0.029 for L=3. configuration=$\pi(1h_{9/2})^{+1}\otimes 2^+$ (1974Cl07).
4223[#] *7*			
4236 *4*			Additional information 31.
4257 *4*			Additional information 32.
4263[#] *7*			
4286 *3*	4	0.034	Additional information 33. L,β_L: L=4+6 from 1971Be32, β_4=0.071 *7*, β_6=0.071 *7* for a level at E=4290 *50*. The equality of β_4,β_6 is an assumption made by 1971Be32 in the analysis of their data.
4294[#] *7*			
4301 *3*	≈7	≈0.033	Additional information 34.
4313[#] *7*			
4326 *3*			Additional information 35.
4333[#] *7*			
4340[#] *7*			
4349[#] *7*			
4363 *3*	4	0.032	Additional information 36.
4373[#] *7*			

Continued on next page (footnotes at end of table)

^{209}Bi(p,p′) 1975Wa03,1974Cl07,1974Cl06 (continued)

^{209}Bi Levels (continued)

E(level)[†]	L[b]	β_L[e]	Comments
4380[#] *7*			
4390[#] *7*			
4397 *3*			Additional information 37.
4411[@] *3*	≈8	≈0.035	
4441[&] *4*	4	0.017	
4469[&] *3*			
4485[@] *4*			
4512[@] *5*			
4532[&] *4*	≈8	≈0.021	
4592[@] *6*			
4613[&] *5*			
≈4700[@]			E(level): unresolved multiplet structure in region 4630-4745.
4760[&] *4*			
4791[&] *6*			
4828[@] *5*			
4853[@] *5*			
4949[&] *4*			
4965[@] *5*			
4998[@] *6*			
5056[&] *5*			
5131[&] *6*	≈7	≈0.022	
5241[@] *7*	4		L: from 1971Be32 for a level at E=5200 *50*.
5282[@] *5*			
5312[&] *5*			
5333[@] *5*			
5360[&] *6*			
5423[&] *6*			
5463[@] *5*			
5509[&] *6*			
5569[&] *10*			
5769[@] *5*			
5795[&] *7*			
5835[&] *8*			
≈6200			E(level): from 1971Be32, probable doublet.

[†] Weighted average of values from 1975Wa03 and 1974Cl07, unless otherwise noted. Energies from 1974Cl07 are relative to the 2741 keV level in ^{209}Bi and energies from 1966Ha35 are relative to the 2615 keV level in ^{208}Pb.
[‡] Energy used for calibration by 1975Wa03.
[#] From 1974Cl07 only.
[@] From 1975Wa03 only.
[&] Probable multiplet from 1975Wa03.
[a] Weighted average of values from 1975Wa03, 1974Cl07 and 1966Ha35.
[b] From 1975Wa03 based on DWBA analysis. Data of 1975Wa03 and 1974Cl07 are in agreement except for three levels as noted.
[c] From 1974Cl07.

Continued on next page (footnotes at end of table)

^{209}Bi(p,p′) 1975Wa03,1974Cl07,1974Cl06 (continued)

^{209}Bi Levels (continued)

[d] L=2 for the 4162+4168 levels.
[e] Data are β_L from 1975Wa03 where $(\beta_L)^2$ is the ratio of σ(exp) to σ(collective model). Other: 1974Cl07. For the 7 states with assumed configuration (^{208}Pb 3$^-$)(p,1h9/2)J (see Adopted Levels), the ratio $(\beta_3)^2/(\beta_3)^2(^{208}\text{Pb } 3^-)$=0.98 *6*. For the ten states with assumed configuration (^{208}Pb 5$^-$)(p,1h9/2)J (see Adopted Levels), the ratio $(\beta_5)^2/(\beta_5)^2(^{208}\text{Pb } 5^-)$=0.88 *6*.