^{208}Pb(t,2nγ) 1983Ma15

History

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

1983Ma15: E=11-16 MeV triton beams were produced from the 3-state Van de Graaff facility of the Los Alamos National Laboratory. Targets were enriched metallic Pb (>98.5%). γ-rays were detected by a pure Ge low-energy photon (LEPS) detector (FWHM=0.5 keV at 100 keV), a pure Ge planar detector (FWHM=1 keV at 800 keV) and a 50 cm^3 coaxial Ge(Li) detector (FWHM=2.5 keV at 1.5 MeV). Measured Eγ, Iγ, $\gamma(\theta)$, $\gamma\gamma$-coin, $\gamma\gamma$-coin. Deduced levels, J^π, branchings. Also see 1983Be28.

^{209}Bi Levels

E(level)†	J$^\pi$‡	Comments
0	9/2$^-$	configuration=$\pi(1h_{9/2})^{+1}$.
896.32 *6*	7/2$^-$	configuration=$\pi(2f_{7/2})^{+1}$.
1608.54 *6*	13/2$^+$	configuration=$\pi(1i_{13/2})^{+1}$.
2442.83 *6*	1/2$^+$	J$^\pi$: 1546$\gamma(\theta)$ is isotropic. configuration=$\pi(3s_{1/2})^{-1}$.
2492.77# *6*	3/2$^+$	
2564.32# *20*	9/2$^+$	
2582.84# *11*	7/2$^+$	
2599.78# *14*	11/2$^+$	
2600.87# *6*	13/2$^+$	
2617.25# *7*	5/2$^+$	
2741.00# *6*	15/2$^+$	
2766.57@ *6*	3/2$^+$	
2826.18 *15*	5/2$^-$	configuration=$\pi(2f_{5/2})^{+1}$.
2845.10@ *7*	1/2$^+$	J$^\pi$: 402$\gamma(\theta)$ to 1/2$^+$ is isotropic (1983Ma15).
2916.53& *8*	1/2$^+$	
2955.85 *8*	3/2$^+$	J$^\pi$: γ-branching ratio to 3/2$^+$ and 5/2$^+$ members of the configuration=$\pi(1h_{9/2})^{+1}\otimes3^-$ septuplet agrees with the calculated value for assignment as a 3/2$^+$ component (fragmented) of the same multiplet (1983Ma15). configuration=$\pi(2d_{3/2})^{-1}+\pi(1h_{9/2})^{+1}\otimes3^-$ (1983Ma15).
2986.73@ *6*	19/2$^+$	
3038.79@ *10*	5/2$^+$	
3090.24@ *10*	7/2$^+$	
3119.56 *12*	3/2$^-$	configuration=$\pi(3p_{3/2})^{+1}$.
3132.77@ *17*	11/2$^+$	
3135.65@ *7*	15/2$^+$	
3153.23@ *20*	9/2$^+$	
3154.02@ *6*	17/2$^+$	
3159.23& *8*	3/2$^+$	
3169.02@ *6*	13/2$^+$	
3197.40 *11*	(1/2$^+$,3/2$^+$,5/2$^+$)	
3211.78& *6*	17/2$^+$	
3221.63& *9*	5/2$^+$	
3269.59 *11*	(1/2$^+$,3/2$^+$,5/2$^+$)	
3311.19 *7*	(7/2$^+$)	
3354.7 *4*	(3/2$^+$)	
3362.0 *4*	(5/2$^+$,7/2$^+$,9/2$^+$)	
3378.2& *3*	9/2$^+$	
3393.34 *21*	(15/2$^+$)	

Continued on next page (footnotes at end of table)

^{208}Pb(t,2nγ) 1983Ma15 (continued)

^{209}Bi Levels (continued)

E(level)[†]	J$^{\pi}$[‡]	Comments
3406.06[&] *11*	13/2$^+$	
3450.2[&] *6*	7/2$^+$	
3464.0[&] *3*	11/2$^+$	
3467.61 *8*	19/2$^+$	
3486.87 *8*	19/2$^+$	probable configuration=$\pi(1h_{9/2})^{+1}\otimes\nu(1i^{+1}_{11/2}3p^{-1}_{1/2})$
3490.2 *3*	(7/2$^+$,9/2$^+$)	
3502.16[&] *12*	15/2$^+$	
3541.6 *3*	(5/2$^+$,7/2$^+$,9/2$^+$)	
3575.7 *4*		
3578.68 *9*	21/2$^+$	probable configuration=$\pi(1h_{9/2})^{+1}\otimes\nu(1i^{+1}_{11/2}3p^{-1}_{1/2})$
3597.09 *10*	19/2$^+$	probable configuration=$\pi(1h_{9/2})^{+1}\otimes\nu(2g^{+1}_{9/2}2f^{-1}_{5/2})$
3601.84 *21*	(9/2$^+$)	
3693.0 *5*	(11/2$^-$)	
3703.58 *21*	(7/2$^+$)	
3719.0 *20*	(7/2$^+$,9/2$^+$,11/2$^+$)	Additional information 1.
3783.6 *4*	(5/2$^+$,7/2$^+$,9/2$^+$)	
3812.18 *16*	23/2$^+$	probable configuration=$\pi(1h_{9/2})^{+1}\otimes\nu(2g_{9/2})^{+1}2f^{-1}_{5/2})$
3853.0 *20*	(7/2$^+$,9/2$^+$,11/2$^+$)	
3979.5 *6*	(7/2$^+$,9/2$^+$,11/2$^+$)	
4141.89 *11*	21/2$^+$	

† From a least-squares fit to γ-ray energies.
‡ From 1983Ma15.
# Member of the $\pi(1h_{9/2})^{+1}\otimes3^-$.
@ configuration=$\pi(1h_{9/2})^{+1}\otimes\nu(2g^{+1}_{9/2}3p^{-1}_{1/2})_{5^-}$
& configuration=$\pi(1h_{9/2})^{+1}\otimes\nu(2g^{+1}_{9/2}3p^{-1}_{1/2})_{4^-}$

γ(^{209}Bi)

Eγ	Iγ[‡]	Ei(level)	J_i^π	Ef	J_f^π	Mult.[†]	α[@]	Comments
(49.9)	≈1.73	2492.77	3/2+	2442.83	1/2+	[M1]	14.46	Iγ: from 1983MA15.Transition not seen directly. Energy from level energy difference and total intensity inferred from γγ to be ≈20% of the branching from the 2493 level.
78.60 10	≈4	2845.10	1/2+	2766.57	3/2+			Iγ: seen only in the low-energy photon detector. Iγ is ≈15% of the 402γ (1983Ma15).
110.67 15	0.70 7	2955.85	3/2+	2845.10	1/2+			A_2=+0.4 3.
124.48 5	1.73 7	2617.25	5/2+	2492.77	3/2+	M1		Mult.: A_2=−0.05 5.
131.45 8	1.28 7	3221.63	5/2+	3090.24	7/2+			A_2=+0.02 15.
140.13 1	38.5 6	2741.00	15/2+	2600.87	13/2+	M1		Mult.: A_2=−0.19 4.
149.3 1	3.8 2	2766.57	3/2+	2617.25	5/2+			A_2=−0.08 8.
149.98 5	7.1 2	2916.53	1/2+	2766.57	3/2+			A_2=+0.04 8.
167.16 6	3.4 1	3154.02	17/2+	2986.73	19/2+	M1		Mult.: A_2=−0.25 10.
225.05 2	34.6 5	3211.78	17/2+	2986.73	19/2+			A_2=−0.15 4.
242.73 5	5.6[#] 7	3159.23	3/2+	2916.53	1/2+			
245.73 2	266 5	2986.73	19/2+	2741.00	15/2+	E2		Mult.: A_2=+0.31 5.
265.74 8	3.7 2	3221.63	5/2+	2955.85	3/2+			
270.4 1	5.5 3	3406.06	13/2+	3135.65	15/2+			A_2=−0.07 7.
272.2 1	8.7 2	3038.79	5/2+	2766.57	3/2+			A_2=−0.02 4.
273.80 3	19.4 3	2766.57	3/2+	2492.77	3/2+			A_2=+0.02 4.
290.38 10	5.7 3	3502.16	15/2+	3211.78	17/2+	M1		Mult.: A_2=−0.13 8.
313.70 16	7.8 8	3467.61	19/2+	3154.02	17/2+	M1		
314.2 2	6.1 8	3159.23	3/2+	2845.10	1/2+	M1		Mult.: A_2=−0.15 10.
323.74 2	61 1	2766.57	3/2+	2442.83	1/2+	M1		Mult.: A_2=−0.08 4.
338.65 10	2.6 3	2955.85	3/2+	2617.25	5/2+			A_2=−0.1 2.
352.30 8	7.0 3	3197.40	(1/2+,3/2+,5/2+)	2845.10	1/2+			A_2=+0.03 5.
392.56 10	4.4 3	3159.23	3/2+	2766.57	3/2+			A_2=+0.07 10.
394.72 7	11.8 3	3135.65	15/2+	2741.00	15/2+	M1		Mult.: A_2=+0.12 8.
402.27 3	26.8 4	2845.10	1/2+	2442.83	1/2+			
413.04 3	51.6 8	3154.02	17/2+	2741.00	15/2+	M1+E2		Mult.: A_2=−0.32 3.
424.49[&] 8	13.2[&] 4	3269.59	(1/2+,3/2+,5/2+)	2845.10	1/2+			A_2=+0.14 3.
424.49[&] 8	13.2[&] 4	3578.68	21/2+	3154.02	17/2+			
443.15 12	4.1 3	3597.09	19/2+	3154.02	17/2+			A_2=−0.1 2.
455.02 10	7.5 3	3221.63	5/2+	2766.57	3/2+			A_2=−0.12 10.
463.04 8	16.6 4	2955.85	3/2+	2492.77	3/2+			A_2=0.00 5.
480.87 5	28.6 6	3467.61	19/2+	2986.73	19/2+	M1		Mult.: A_2=+0.43 4.
500.12 5	35.3 7	3486.87	19/2+	2986.73	19/2+	M1		Mult.: A_2=+0.42 4.
(513.0)	<0.8	2955.85	3/2+	2442.83	1/2+			Eγ: not seen. Eγ is from the level energy difference. The authors quote an upper limit of 3% for the branching to the 2443 level (value given in text in 1983Ma15).
544.85 10	15.9 5	4141.89	21/2+	3597.09	19/2+	M1		Mult.: A_2=−0.23 7.
588.1 4	10.3 6	3354.7	(3/2+)	2766.57	3/2+			A_2=+0.05 8.
592.2 1	10.5 6	3578.68	21/2+	2986.73	19/2+	M1		Mult.: A_2=−0.36 12.

γ(^{209}Bi) (continued)

E_γ	I_γ[‡]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[†]	δ	Comments
610.33 *15*	22.3 *7*	3597.09	19/2$^+$	2986.73	19/2$^+$	M1		Mult.: A_2=+0.49 *7*.
654.98 *10*	17.8 *7*	4141.89	21/2$^+$	3486.87	19/2$^+$	M1		Mult.: A_2=−0.28 *8*.
664.8 *2*	9.4 *6*	3703.58	(7/2$^+$)	3038.79	5/2$^+$	M1		Mult.: A_2=−0.25 *10*.
806.36 *15*	7.8[#] *9*	3406.06	13/2$^+$	2599.78	11/2$^+$			
825.45 *15*	13.8 *7*	3812.18	23/2$^+$	2986.73	19/2$^+$	E2		Mult.: A_2=+0.36 *7*.
896.30 *7*	1000 *10*	896.32	7/2$^-$	0	9/2$^-$	M1+E2		A_2=+0.04 *2*.
991.2	<4	2599.78	11/2$^+$	1608.54	13/2$^+$			E_γ: from level energy difference. I_γ: transition not observed. Intensity is limit based on possible component in the 992.34 peak.
992.34 *2*	225 *3*	2600.87	13/2$^+$	1608.54	13/2$^+$	M1+E2		Mult.: A_2=+0.27 *1*.
1132.45 *2*	180 *2*	2741.00	15/2$^+$	1608.54	13/2$^+$	M1+E2	+0.05	Mult.,δ: A_2=−0.12 *1*.
1524.1 *3*	10.2[#] *9*	3132.77	11/2$^+$	1608.54	13/2$^+$			A_2=−0.04 *10*.
1527.02 *8*	87 *1*	3135.65	15/2$^+$	1608.54	13/2$^+$	M1		Mult.: A_2=−0.06 *2*.
1546.47 *5*	196 *2*	2442.83	1/2$^+$	896.32	7/2$^-$	E3		Mult.: γ(θ) to 1/2$^-$ is isotropic.
1560.48 *2*	44 *5*	3169.02	13/2$^+$	1608.54	13/2$^+$	M1		Mult.: A_2=+0.18 *5*.
1608.48 *8*	1000 *6*	1608.54	13/2$^+$	0	9/2$^-$	M2+E3		A_2=+0.42 *1*.
1686.52 *10*	46.8 *8*	2582.84	7/2$^+$	896.32	7/2$^-$	E1+M2		Mult.: A_2=+0.08 *2*.
1720.95 *10*	33[#] *8*	2617.25	5/2$^+$	896.32	7/2$^-$			A_2=−0.04 *4*.
1784.8 *2*	16.2 *5*	3393.34	(15/2$^+$)	1608.54	13/2$^+$	M1		Mult.: A_2=−0.21 *4*.
1797.4 *2*	16.0 *5*	3406.06	13/2$^+$	1608.54	13/2$^+$	M1		Mult.: A_2=+0.23 *4*.
1929.7 *2*	15 *4*	2826.18	5/2$^-$	896.32	7/2$^-$			
2142.52 *15*	34 *3*	3038.79	5/2$^+$	896.32	7/2$^-$	E1		Mult.: A_2=−0.07 *3*.
2194.3 *2*	5.9[#] *6*	3090.24	7/2$^+$	896.32	7/2$^-$			A_2=+0.10 *12*.
2223.23 *10*	65 *2*	3119.56	3/2$^-$	896.32	7/2$^-$	E2		Mult.: A_2=+0.09 *5*.
2414.85 *3*	16.9 *6*	3311.19	(7/2$^+$)	896.32	7/2$^-$			A_2=+0.03 *5*.
2465.7 *4*	13.0 *7*	3362.0	(5/2$^+$,7/2$^+$,9/2$^+$)	896.32	7/2$^-$			A_2=−0.01 *10*.
2481.7 *4*	<1.5	3378.2	9/2$^+$	896.32	7/2$^-$			I_γ: from branching relative to the 3378γ as given in authors′ Table II.
2492.72 *10*	170 *10*	2492.77	3/2$^+$	0	9/2$^-$			A_2=+0.04 *2*.
2553.9 *6*		3450.2	7/2$^+$	896.32	7/2$^-$			A_2=+0.10 *17*.
2564.3 *2*	65 *2*	2564.32	9/2$^+$	0	9/2$^-$	E1		Mult.: A_2=+0.25 *3*.
2582.7 *4*	20.4 *10*	2582.84	7/2$^+$	0	9/2$^-$	E1+M2		Mult.: A_2=+0.20 *5*.
2593.5 *3*	12 *3*	3490.2	(7/2$^+$,9/2$^+$)	896.32	7/2$^-$			
2599.9 *2*	89 *2*	2599.78	11/2$^+$	0	9/2$^-$	E1		Mult.: A_2=−0.11 *4*.
2600.8	<11	2600.87	13/2$^+$	0	9/2$^-$			E_γ: from level energy difference. I_γ: transition not observed. Intensity is limit based on possible component in the 2599.9 peak.
2617.25 *15*	19 *4*	2617.25	5/2$^+$	0	9/2$^-$			
2645.3 *3*		3541.6	(5/2$^+$,7/2$^+$,9/2$^+$)	896.32	7/2$^-$			A_2=+0.05 *5*.
2679.4 *4*	29 *5*	3575.7		896.32	7/2$^-$			
2705.5 *2*	22 *5*	3601.84	(9/2$^+$)	896.32	7/2$^-$	E1		Mult.: A_2=−0.29 *8*.
2740.99 *7*	266 *2*	2741.00	15/2$^+$	0	9/2$^-$	E3		Mult.: A_2=+0.48 *1*.
2826.3 *2*	46 *1*	2826.18	5/2$^-$	0	9/2$^-$	E2		Mult.: A_2=+0.17 *5*.

γ(^{209}Bi) (continued)

E_γ	I_γ[‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[†]	Comments
2887.3 *4*	12.0 *7*	3783.6	(5/2$^+$,7/2$^+$,9/2$^+$)	896.32	7/2$^-$		Mult.: A_2=+0.17 *10*.
3090.2 *2*	33 *1*	3090.24	7/2$^+$	0	9/2$^-$	E1+M2	Mult.: A_2=+0.10 *5*.
3132.8 *2*	36 *1*	3132.77	11/2$^+$	0	9/2$^-$	E1	Mult.: A_2=−0.24 *4*. E_γ: the authors′ value of 3132.85 *2* is a misprint.
3153.2 *2*	37 *1*	3153.23	9/2$^+$	0	9/2$^-$	E1	Mult.: A_2=+0.26 *6*.
3378.3 *4*	13.5 *7*	3378.2	9/2$^+$	0	9/2$^-$	E1	Mult.: A_2=+0.10 *5*.
3464.0 *3*	13.3 *8*	3464.0	11/2$^+$	0	9/2$^-$	E1	Mult.: A_2=−0.28 *8*.
3491.0 *5*	5[#] *3*	3490.2	(7/2$^+$,9/2$^+$)	0	9/2$^-$		
3693.0 *5*		3693.0	(11/2$^-$)	0	9/2$^-$		
3703.4 *6*	8.4[#] *22*	3703.58	(7/2$^+$)	0	9/2$^-$		
3719 *2*		3719.0	(7/2$^+$,9/2$^+$,11/2$^+$)	0	9/2$^-$		
3853 *2*		3853.0	(7/2$^+$,9/2$^+$,11/2$^+$)	0	9/2$^-$		
3979.5 *6*		3979.5	(7/2$^+$,9/2$^+$,11/2$^+$)	0	9/2$^-$		A_2=−0.05 *10*.

† Tentative assignments from 1983Ma15 based on $\gamma(\theta)$ and spin-parity assignments, unless otherwise noted.
‡ Relative thick target yields integrated over all angles from E=16−MeV spectrum (1983Ma15). Authors also give Iγ at 13 MeV.
\# Since Iγ at 16 MeV is not given, the quoted value is from branching reported in the 13-MeV data.
@ 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.
& Multiply placed with undivided intensity.

$^{209}_{83}$Bi$_{126}$-5

$^{208}Pb(t,2n\gamma)$ 1983Ma15

Level Scheme

Intensities: Relative I_γ

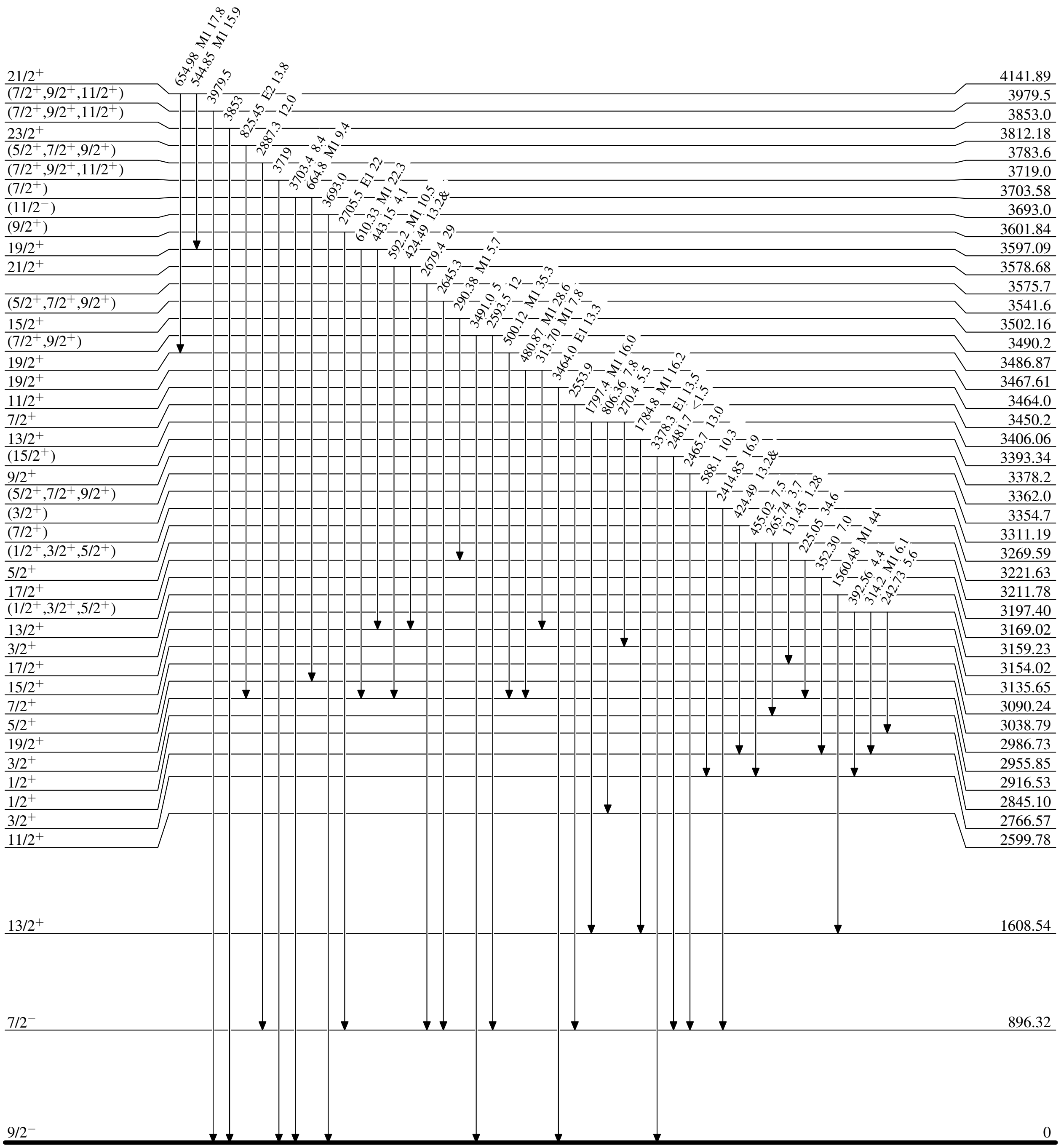
& Multiply placed: undivided intensity given

Legend

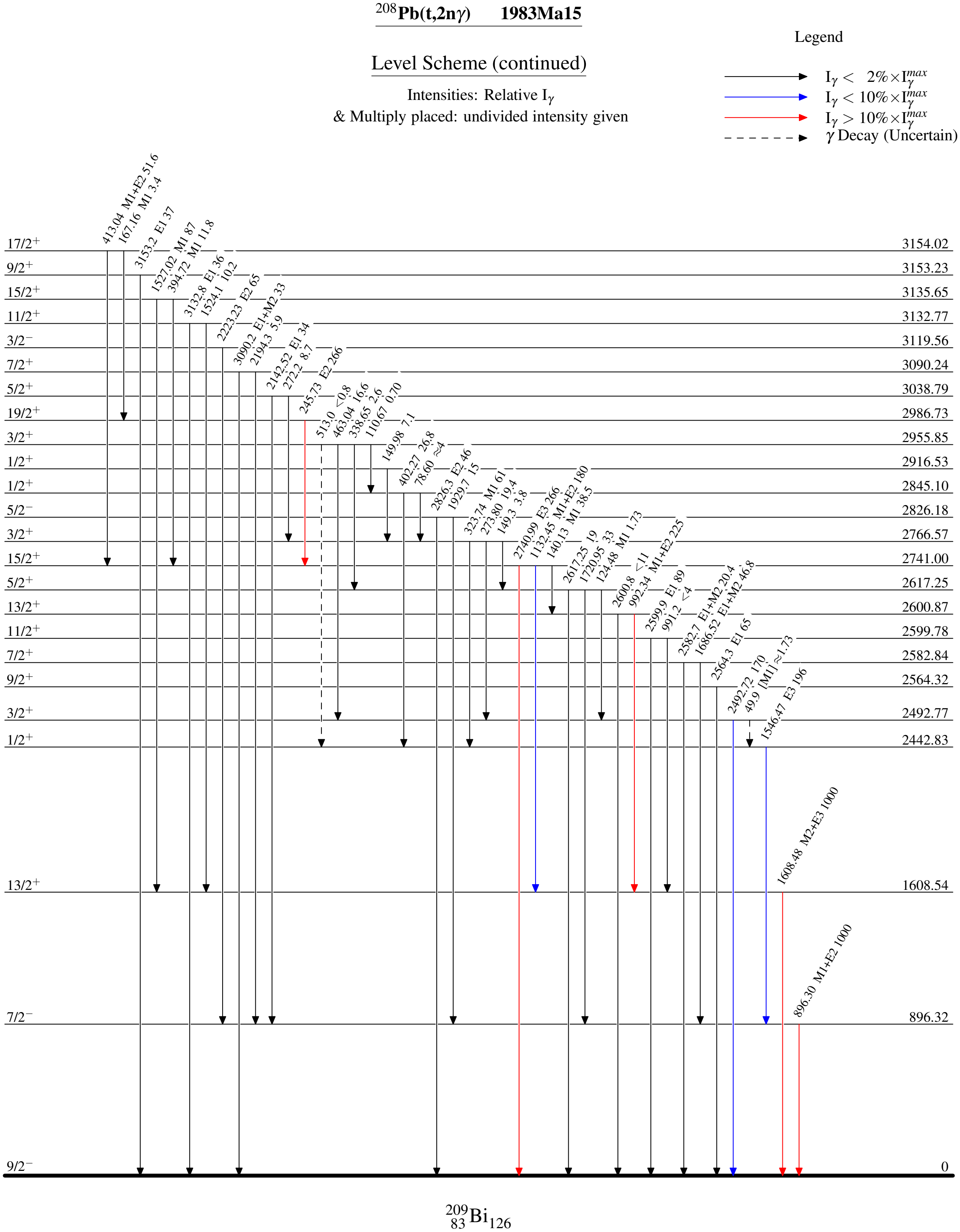
$I_\gamma < 2\% \times I_\gamma^{max}$

$I_\gamma < 10\% \times I_\gamma^{max}$

$I_\gamma > 10\% \times I_\gamma^{max}$



$^{209}_{83}Bi_{126}$


^{208}Pb(t,2nγ) 1983Ma15
Level Scheme (continued)
Intensities: Relative Iγ
& Multiply placed: undivided intensity given
Legend
Iγ < 2%×Iγmax
Iγ < 10%×Iγmax
Iγ > 10%×Iγmax
γ Decay (Uncertain)
17/2+ 3154.02
9/2+ 3153.23
15/2+ 3135.65
11/2+ 3132.77
3/2− 3119.56
7/2+ 3090.24
5/2+ 3038.79
19/2+ 2986.73
3/2+ 2955.85
1/2+ 2916.53
1/2+ 2845.10
5/2− 2826.18
3/2+ 2766.57
15/2+ 2741.00
5/2+ 2617.25
13/2+ 2600.87
11/2+ 2599.78
7/2+ 2582.84
9/2+ 2564.32
3/2+ 2492.77
1/2+ 2442.83
13/2+ 1608.54
7/2− 896.32
9/2− 0
$^{209}_{83}$Bi$_{126}$