^{209}Bi(α,5nγ) 1984Fa10

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	M. J. Martin	NDS 108,1583 (2007)	1-Jun-2007

E=51-60 MeV. Measured γ(θ), γ(t), γγ(t), Iγ, Ice, E(γ).

^{208}At Levels

E(level)†	Jπ‡	$T_{1/2}$	Comments
0	6+		
71.83	7+		E(level): from Adopted Levels.
788.4	8+		
904.0	9+		
1090.5	10−	47.8 ns *10*	g=0.269 *3* (1985No09,2005St24) the g-factor is from a time-dependent perturbed angular correlation measurement and is corrected for diamagnetism and the Knight shift. $T_{1/2}$: from 1985No09. Other: 45 ns *2* (1984Fa10).
1255.7	10+		
1299.9	11+		
1376.1	12+		
1525.5	13+		
1544.7	11−		
1648.7	12−		
1804.2	13+		
2194.2	13−		
2226.7	14−		
2268.8	13−		
2276.4	16−	1.5 μs *2*	Q=1.69 *25* (1991Sc15,2005St24) $T_{1/2}$: from 1984Fa10. Q: value first reported by 1987HaYZ, and later by 1987Sc21, 1990Ha30, and 1991Sc15. The authors used the level-mixing spectroscopy technique (lems), which requires knowing the μ value. Since this has not been measured for ^{208}At, the authors deduced μ=15.7 from single-particle values In ^{209}At and ^{207}Pb. The Q value is relative to that for ^{211}At, for which the field gradient has been deduced.
2371.8	14−		
2480.4	14−		
2717.1	15−		
2745.4	17−		
2768.7	15−		
2771.4	14−		
2801.7	(15,16)		
2829.6	17−		
2935.9			
3123.1	16−		
3269.0	(16−)		
3283.6	(17,18)		
3307.7			
3315.9?	(15,16)		
3333.2	(17−)		
3460.3			
3479.3			
3547.0			
3867.0	(18−)		
4366.9?			

† From a least-squares fit to the Eγ values with the energy of the first excited level held fixed At 71.83. No uncertainties are given

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^{209}Bi(α,5nγ) 1984Fa10 (continued)

^{208}At Levels (continued)

for the Eγ values, so the uncertainties are assumed to Be the same for all transitions.
‡ From the authors based on γ(θ) and α(K)exp data. Specific arguments for some levels are given In Adopted Levels. For the assignments of other levels, the evaluator has referred the reader to the authors′ paper.

γ(^{208}At)

E_γ	I_γ‡	E_i(level)	J^π_i	E_f	J^π_f	Mult.†	Comments
42.1		2268.8	13⁻	2226.7	14⁻	(M1)	Eγ: from level scheme. Not observed but required by γγ. Mult.: the authors point out that the absence of a measurable halflife (<1 ns) suggests that the transition is mainly dipole. Placement In the level scheme requires Δπ=No.
44.5	2.1	1299.9	11⁺	1255.7	10⁺	M1(+E2)	Mult.: from an intensity balance At the 1255 level, and the assumption that there is No direct feeding of the 1255 level, one gets α=37, compared with α(theory)=0.88 (E1), 24.8 (M1), and 361 (E2). Any direct feeding of the 1255 level would decrease the deduced α value. The placement requires Δπ=No. The authors point out that the absence of a measurable halflife (<1 ns) suggests that the mult is mainly dipole.
54.3		2771.4	14⁻	2717.1	15⁻	(M1)	Eγ: from level scheme. Not observed but required by γγ. Mult.: from the non-measurable halflife (<1 ns), the authors suggest that the mult must Be mainly dipole. Placement In the level scheme requires Δπ=No.
64.2	0.3	3333.2	(17⁻)	3269.0	(16⁻)	(M1)	Mult.: from the non-measurable halflife (<1 ns), the authors suggest that the mult must Be mainly dipole. Placement In the level scheme suggests Δπ=No.
71.7	26 *3*	71.83	7⁺	0	6⁺	M1(+E2)	Mult.: from an intensity balance At the 72 level, and the assumption that there is No direct feeding of the 72 level, one gets α=6.1, In good agreement with the M1 theory value of 6.11. Any direct feeding of this level would increase the deduced α and require some E2 admixture; however, As pointed out by the authors, the absence of a measurable halflife (<1 ns) suggests that the mult is mainly dipole.
76.2	23	1376.1	12⁺	1299.9	11⁺	M1	Mult.: from an intensity balance At the 1300 level, and the assumption that there is No direct feeding of the 1300 level, one gets α=4.0. Any direct feeding would decrease this value. From an intensity balance At the 1300 In the 1.5-ns delayed spectrum, using the authors data from table 2, one gets α≥4.4. These two results establish mult=M1.
104.2	≤1.0	1648.7	12⁻	1544.7	11⁻	(M1)	Mult.: the authors point out that the absence of a measurable halflife (<1 ns) for this low-energy transition suggests mult=mainly dipole. Placement In the level scheme requires Δπ=No.
106.1	≤1.0	2935.9		2829.6	17⁻		
115.7	1.6 *2*	904.0	9⁺	788.4	8⁺		
145.9	≤6.0	3269.0	(16⁻)	3123.1	16⁻		Mult.: A_2=+0.17 *8*, A_4=−0.19 *11*. ΔJ=0.
149.4	21	1525.5	13⁺	1376.1	12⁺	M1(+E2)	Mult.: A_2<0. From an intensity balance At the 1526 level In the 1.5-ns delayed spectrum, one gets α≥3.9. Compared with α(theory)=0.17 (E1), 3.86 (M1), and 1.47 (E2), and the non-measurable halflife (<1 ns), one get mult=mainly M1.
184.1	≤5.0	3307.7		3123.1	16⁻		
186.5	100 *5*	1090.5	10⁻	904.0	9⁺	E1	Mult.: α(L)exp<0.014. A_2≈0.
190.6	≤0.5	2935.9		2745.4	17⁻		Eγ: seen only In γγ.
226.0	≤5.8@	1525.5	13⁺	1299.9	11⁺	(E2)	Mult.: A_2=−0.09 *1*, A_4=−0.18 *1*.
253.6	2.3	2480.4	14⁻	2226.7	14⁻	(M1)	Mult.: A_2=+0.32 *7*, A_4=+0.10 *10*.
278.7	32	1804.2	13⁺	1525.5	13⁺	M1	Mult.: α(K)exp=0.58 *9*. A_2=+0.09 *11*, A_4=−0.55 *16*.

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^{209}Bi(α,5nγ) 1984Fa10 (continued)

γ(^{208}At) (continued)

E_γ	I_γ[‡]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[†]	Comments
286.3	5.3	2480.4	14⁻	2194.2	13⁻	M1	Mult.: α(K)exp=0.74 *15* for the 286.3γ+288.2γ. A_2=−0.32 *4*, A_4=−0.28 *6*. The data are consistent only with mult=M1 for both transitions.
288.2	6.4	2768.7	15⁻	2480.4	14⁻	M1	Mult.: α(K)exp=0.74 *15* for the 286.3γ+288.2γ. A_2=−0.25 *3*, A_4=−0.25 *5*. The data are consistent only with mult=M1 for both transitions.
345.2	6.5	2717.1	15⁻	2371.8	14⁻	M1	Mult.: α(K)exp=0.51 *10*. A_2=−0.20 *4*, A_4=−0.48 *6*.
351.9	6.3	1255.7	10⁺	904.0	9⁺	(M1)	Mult.: α(K)exp=0.29 *5* for the 351.9γ+354.4γ. A_2=+0.14 *2*, A_4=−0.17 *4*.
354.4	15	3123.1	16⁻	2768.7	15⁻		Mult.: α(K)exp=0.29 *5* for the 351.9γ+354.4γ. A_2=−0.22 *1*, A_4=−0.21 *2*. The authors assign mult=M1 or E1. Placement In the level scheme requires $\Delta\pi$=No.
396.0	58	1299.9	11⁺	904.0	9⁺	E2	Mult.: stretched E2 from $\gamma(\theta)$. α(K)exp=0.036 *5*. A_2=+0.38 *5*, A_4=−0.12 *7*.
454.2	8.1	1544.7	11⁻	1090.5	10⁻	M1	Mult.: α(K)exp=0.14 *3*. A_2=−0.10 *3*, A_4=−0.13 *5*.
467.1	70	1255.7	10⁺	788.4	8⁺	E2	Mult.: α(K)exp=0.038 *8*. A_2=+0.36 *4*, A_4=−0.10 *6*.
469.1	17	2745.4	17⁻	2276.4	16⁻	M1	Mult.: α(K)exp=0.17 *3*. A_2=−0.26 *2*, A_4=−0.03 *3*.
472.2	23	2276.4	16⁻	1804.2	13⁺	E3	Mult.: α(K)exp=0.059 *12*. A_2=+0.12 *4*, A_4=−0.16 *6*.
481.9	4.9	3283.6	(17,18)	2801.7	(15,16)		Mult.: A_2=+0.57 *3*, A_4=−0.28 *3*.
490.5	7.5	2717.1	15⁻	2226.7	14⁻	M1	Mult.: α(K)exp=0.15 *3*. A_2=−0.29 *2*, A_4=−0.10 *3*.
499.9[&]	3.3	4366.9?		3867.0	(18⁻)		Mult.: A_2=−0.19 *16*, A_4=−0.26 *22*.
502.6	11	2771.4	14⁻	2268.8	13⁻	M1	Mult.: α(K)exp=0.23 *5*. A_2=−0.31 *4*, A_4=−0.22 *6*.
533.8	14[@]	3867.0	(18⁻)	3333.2	(17⁻)	(M1)	Mult.: α(K)exp=0.12 *2*. A_2>0.
542.1	≤10	2768.7	15⁻	2226.7	14⁻	M1	Mult.: α(K)exp=0.14 *3*. A_2=−0.16 *5*, A_4=+0.05 *7*.
544.5[&]	—?<30[#]	3315.9?	(15,16)	2771.4	14⁻		
545.6	≤30[#]	2194.2	13⁻	1648.7	12⁻		
553.1	22	2829.6	17⁻	2276.4	16⁻	M1	Mult.: α(K)exp=0.087 *14*. A_2=−0.44 *5*, A_4=−0.07 *3*.
558.2	≈70	1648.7	12⁻	1090.5	10⁻	E2	Mult.: stretched E2 from $\gamma(\theta)$. α(K)exp≤0.023. A_2=+0.31 *3*, A_4=−0.14 *4*.
567.5	6.8	2371.8	14⁻	1804.2	13⁺		Mult.: A_2=+0.11 *5*, A_4=−0.07 *6*.
575.0	≤10	2801.7	(15,16)	2226.7	14⁻		
577.8	≤50	2226.7	14⁻	1648.7	12⁻		Mult.: A_2>0.
611.1	2.4	3547.0		2935.9			
620.1	9.8	2268.8	13⁻	1648.7	12⁻	M1+E2	Mult.: α(K)exp=0.040 *12*. A_2=−0.15 *8*, A_4=−0.10 *11*.
630.7	8.4	3460.3		2829.6	17⁻		Mult.: A_2>0.
701.3	10	2226.7	14⁻	1525.5	13⁺		Mult.: A_2≈0. The authors assign mult=E1(+M2) but show No α(K)exp. This assignment is perhaps based on the absence of any ce line.
716.7	14.0 *14*	788.4	8⁺	71.83	7⁺	M1	Mult.: α(K)exp=0.030 *9*. A_2=−0.35 *4*, A_4=−0.030 *9*.
733.9	1.6	3479.3		2745.4	17⁻		
750.9	29	2276.4	16⁻	1525.5	13⁺	E3	Mult.: α(K)exp=0.031 *6*. A_2=+0.19 *4*, A_4=−0.03 *6*.
788.2	69 *7*	788.4	8⁺	0	6⁺	E2	Mult.: α(K)exp=0.012 *4*. A_2=+0.32 *27*, A_4=+0.14 *35*.
832.2	168 *8*	904.0	9⁺	71.83	7⁺	E2	Mult.: α(K)exp=0.0087 *12*. A_2=+0.30 *3*, A_4=−0.08 *5*.
1018.5	≈0.7	1090.5	10⁻	71.83	7⁺		E_γ: authors′ value of 1118.5 In table 1 and In the drawing must Be a misprint. The transition is placed connecting the 1090 and 72 levels.

† From α(K)exp based on relative Iγ and Ice(K) data normalized so that α(K)exp(832.2γ)=0.0087 (E2 theory). This normalization leads to consistency with $\gamma(\theta)$ data which yield stretched quadrupole character for the 396.0, 558.2, 788.2 and 832.2 γ′s and stretched dipole character for the 716.7γ.

‡ Relative photon intensity normalized to 100 for the 186γ. The authors state that the uncertainties are≈5% for the strong

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^{209}Bi(α,5nγ) 1984Fa10 (continued)

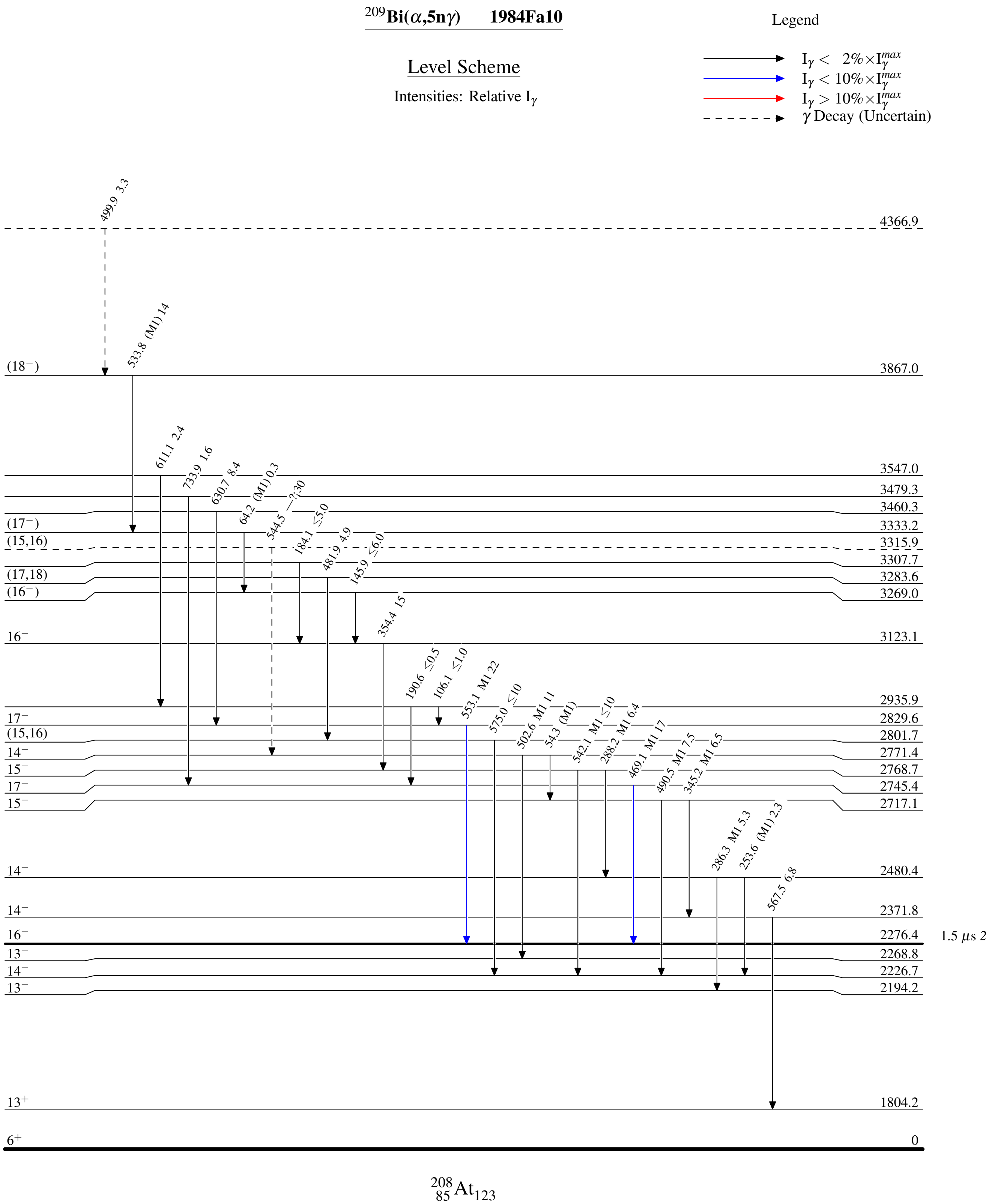
γ(^{208}At) (continued)

transitions and≈10% for the weak transitions. For inclusion In Adopted Gammas, the evaluator has chosen Iγ=30 as the division between weak and strong.

Iγ≈30 for the 544.5 + 545.6 doublet.

@ Doublet.

& Placement of transition in the level scheme is uncertain.

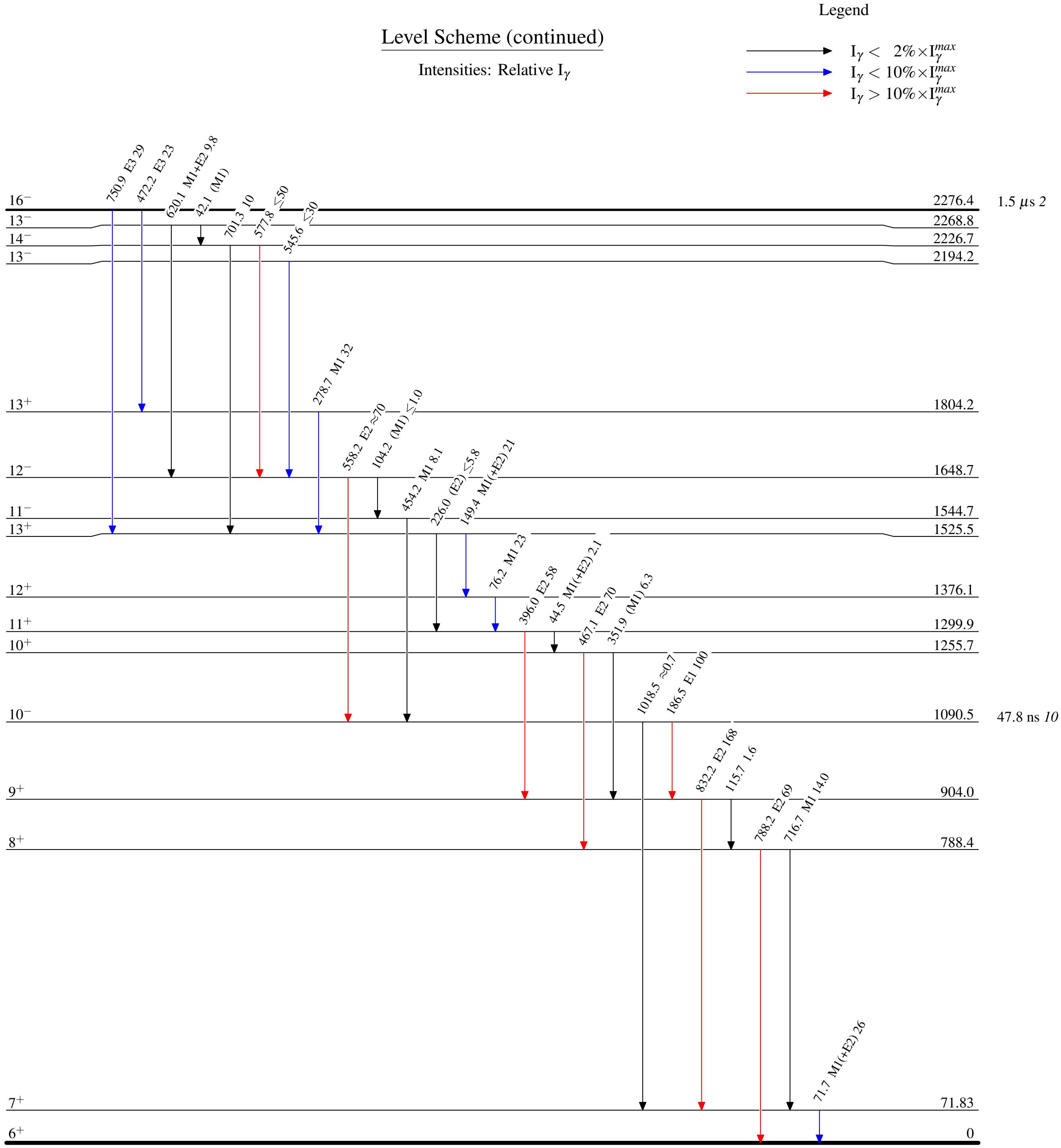


^{209}Bi(α,5nγ) 1984Fa10
Level Scheme
Intensities: Relative I_γ
Legend
$I_\gamma < 2\% \times I_\gamma^{max}$
$I_\gamma < 10\% \times I_\gamma^{max}$
$I_\gamma > 10\% \times I_\gamma^{max}$
γ Decay (Uncertain)
499.9 3.3
4366.9
533.8 (M1) 14
(18⁻) 3867.0
611.1 2.4
733.9 1.6
630.7 8.4
64.2 (M1) 0.3
544.5 ~2.30
184.1 ≤5.0
481.9 4.9
145.9 ≤6.0
354.4 15
3547.0
3479.3
3460.3
(17⁻) 3333.2
(15,16) 3315.9
3307.7
(17,18) 3283.6
(16⁻) 3269.0
16⁻ 3123.1
190.6 ≤0.5
106.1 ≤1.0
553.1 M1 22
575.0 ≤10
502.6 M1 11
54.3 (M1)
542.1 M1 ≤10
288.2 M1 6.4
469.1 M1 17
490.5 M1 7.5
345.2 M1 6.5
2935.9
17⁻ 2829.6
(15,16) 2801.7
14⁻ 2771.4
15⁻ 2768.7
17⁻ 2745.4
15⁻ 2717.1
286.3 M1 5.3
253.6 (M1) 2.3
567.5 6.8
14⁻ 2480.4
14⁻ 2371.8
16⁻ 2276.4 1.5 μs 2
13⁻ 2268.8
14⁻ 2226.7
13⁻ 2194.2
13⁺ 1804.2
6⁺ 0
$^{208}_{85}At_{123}$

$^{209}Bi(\alpha,5n\gamma)$ 1984Fa10

Level Scheme (continued)

Intensities: Relative I_γ



$^{208}_{85}At_{123}$