^{29}Si(α,p),(α,pγ) 1976Va09

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Christian Ouellet, Balraj Singh	NDS 112, 2199 (2011)	24-Aug-2011

1976Va09: (α,pγ) E=12.80, 12.93 and 16.30 MeV α from the Utrecht 6 MV Tandem Van de Graaff accelerator. Si surface barrier detectors for protons, Ge and NaI(Tl) detectors for γ. Measured Eγ, Iγ, lifetimes using DSAM and pγ angular correlations for spins and mixing ratios. Also from the same group but at differing E(α): E=10.65-11 MeV (1973Va14), E=7-11 MeV (1970Va12).

1973Ca18: (α,pγ) E=8.0-9.5 MeV α at Oliver Lodge Laboratory, Liverpool. SiO_2 targets. Ge and NaI(Tl) detectors. Measured Eγ, Iγ and $T_{1/2}$ using DSAM.

1971Go10: (α,pγ) E=4.52 MeV α from the tandem accelerator at the Naval Research California Institute of Technology. $^{29}SiO_2$ targets. Used a measurement of the physical recoil distance of the ^{32}P nuclei to get the lifetime of the 78-keV state. While displacing an absorbing shield in mm increments they measured the relative yield of γ rays using a Ge detector mounted at 90°.

1987Da03: (α,p) E=25 MeV. Measured $\sigma(\theta)$ for 0+78, 510, 1150, 1320, 1750 and 4610 states; DWBA analysis.

Others: 1971St33, 1970Mo09,

^{32}P Levels

E(level)†	J$^\pi$#	$T_{1/2}$&	Comments
0	1$^+$		
78.2 *1*	2$^+$@	278 ps *9*	J$^\pi$: 1$^+$,2$^+$ for unresolved g.s.+78 In 1987Da03; J=5/2 transfer fits best. $T_{1/2}$: from 1971Go10. Additional information 1.
512.9 *2*	0	<7 fs	$T_{1/2}$: from 1973Va14. Additional information 2. J$^\pi$: J=1/2 transfer fits well In 1987Da03.
1149.8 *2*	1$^+$	97 fs *27*	J$^\pi$: from angular distribution 1987Da03. $T_{1/2}$: weighted average from τ=210 fs *44* (1973Ca18), 70 fs *40* (1973Va14). J$^\pi$: J=1/2 transfer fits better than 3/2 In 1987Da03. Additional information 3.
1323.2 *2*	2$^+$	28 fs *8*	$T_{1/2}$: from 1973Va14 other: 402 fs *38* (1973Ca18). Additional information 4. J$^\pi$: J=5/2 transfer fits better than 3/2 In 1987Da03.
1754.4 *2*	3$^+$	427 fs *38*	Additional information 5. $T_{1/2}$: from 1973Ca18. J$^\pi$: J=7/2 transfer fits better than 5/2 In 1987Da03.
2177.6 *2*	3$^+$	68 fs *10*	Additional information 6. $T_{1/2}$: weighted average of τ=63 fs *10* (1973Ca18), 90 fs *21* (1973Va14).
2218.9 *2*	2$^+$	185 fs *17*	Additional information 7. $T_{1/2}$: weighted average of 199 fs *17* (1973Ca18), 146 fs *28* (1973Va14).
2230	2$^+$	0.26 ps *6*	$T_{1/2}$: from 1973Va14. Additional information 8.
2658.0‡ *10*	2$^+$	<28 fs	Additional information 9. $T_{1/2}$: from 1973Ca18.
2746.0‡ *7*	1,2	4.9 ps *+21−12*	J$^\pi$: from angular correlation in 1971St33. Additional information 10. $T_{1/2}$: from 1973Ca18.
3005.4‡ *5*	3$^+$	60 fs *3*	Additional information 11. $T_{1/2}$: from 1973Ca18.
3149.3 *3*	4$^+$	354 fs *25*	Additional information 12. $T_{1/2}$: from 1973Ca18.
3260	2$^-$		J$^\pi$: from 1973Va14.
3320‡	3$^-$	250 fs *10*	J$^\pi$: from 1973Va14. Additional information 13. $T_{1/2}$: from 1973Ca18.
3443			

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^{29}Si(α,p),(α,pγ) 1976Va09 (continued)

^{32}P Levels (continued)

E(level)[†]	J$^{\pi}$[#]	T$_{1/2}$[&]	Comments
3445.2[‡] *4*	4$^-$	24 fs *10*	Additional information 14. T$_{1/2}$: from 1973Ca18.
3797.3 *4*		49 fs *26*	Additional information 15. T$_{1/2}$: from 1973Ca18, other: 66 fs<(1976Va09).
3800	3$^-$		
3875 *2*			
3881.0[‡] *5*	2$^+$	19 fs *15*	Additional information 16. T$_{1/2}$: from 1973Ca18.
3988.7 *5*		12 fs *6*	Additional information 17. T$_{1/2}$: from 1976Va09, other: 7 fs<(1973Ca18).
4010.0			
4034.6 *4*	4$^+$,(2$^+$)	24 fs *17*	T$_{1/2}$: from 1976Va09. Additional information 18.
4040.0			
4148.8 *4*	3$^-$	38 fs *14*	Additional information 19. T$_{1/2}$: weighted average of 36 fs *14* (1973Ca18), 49 fs *35* (1976Va09). T$_{1/2}$: τ=52 fs *20* (1973Ca18), 70 fs *50* (1976Va09).
4203 *3*			
4275.2 *4*	5$^-$	0.54 ps *8*	T$_{1/2}$: from 1976Va09. Additional information 20.
4312.5 *7*		55 fs *28*	T$_{1/2}$: from 1976Va09. Additional information 21.
4554.4 *8*			
4660.0			E(level): a 4610 group is reported In 1987Da03 with possible J$^{\pi}$=0$^+$ from similarity of $\sigma(\theta)$ pattern with that of 510 level.
4697.0 *7*			
4743.3 *4*	5$^+$,(3$^+$)		T$_{1/2}$: from 1976Va09. Additional information 22.
4849.9 *7*			
4880.0			
5070.0		104 fs *34*	T$_{1/2}$: from 1976Va09. Additional information 23.
5081.5 *15*			
5252.9 *12*		<59 fs	T$_{1/2}$: from 1976Va09. Additional information 24.

[†] From 1976Va09 and 1973Va14, unless otherwise noted.
[‡] From 1973Ca18.
[#] From 1976Va09, unless otherwise noted.
[@] From Adopted Levels.
[&] Results from 1973Va14 without a carbon backing lead to different half-lives however not all experiments explicitly say what backing they are using.

γ(^{32}P)

A$_2$ and A$_4$ from 1976Va09 angular correlation are the most precise of the many values they list.

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^{29}Si(α,p),(α,pγ) 1976Va09 (continued)

γ(^{32}P) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[‡#]	δ[‡]	Comments
78.2	2+	78.2 *1*		0	1+			E_γ: from 1971Go10.
512.9	0	434	<2	78.2	2+			
		512	100	0	1+			
1149.8	1+	637[@]	49.7 *17*	512.9	0			Additional information 25.
		1072[@]	42.8 *13*	78.2	2+			Additional information 26.
		1150	7.5 *7*	0	1+			Additional information 27.
1323.2	2+	173	<1	1149.8	1+			
		808	<2	512.9	0			
		1245[@]	40.6 *10*	78.2	2+			Mult.,δ: +0.27 *7* or −8 *−11+3* (1973Va14). Additional information 28.
		1323	59.4 *10*	0	1+			Mult.,δ: +0.4 *2* or +1.42 *13* (1973Va14). Additional information 29.
1754.4	3+	431[@]	2.0 *2*	1323.2	2+	M1+E2	+0.12[#] *10*	Additional information 30.
		604	<1	1149.8	1+			
		1242	<2	512.9	0			
		1677[@]	95.9 *5*	78.2	2+	M1+E2	0.45 *6*	δ: from 1970Mo09. Additional information 31.
		1754	2.1 *5*	0	1+			Additional information 32.
2177.6	3+	423	<1	1754.4	3+			
		854	<3	1323.2	2+			
		1027	<3	1149.8	1+			
		1665	<1	512.9	0			
		2100[@]	91.0 *9*	78.2	2+	M1+E2	−0.14 *3*	Additional information 33.
		2178[@]	9.0 *9*	0	1+	E2(+M3)	+0.09 *11*	Additional information 34.
2218.9	2+	464	<1	1754.4	3+			
		896[@]	31.5 *15*	1323.2	2+	M1		Additional information 35.
		1069[@]	9 *2*	1149.8	1+			Additional information 36.
		1706	<3	512.9	0			
		2141[@]	12 *2*	78.2	2+			Additional information 37.
		2219[@]	47 *2*	0	1+	M1+E2	+0.5[#] *2*	Additional information 38.
2230	2+	476	<4	1754.4	3+			
		910	<1	1323.2	2+			
		1081	<5	1149.8	1+			
		1720	<1	512.9	0			
		2152[@]	81 *3*	78.2	2+			Additional information 39.
		2230[@]	19 *3*	0	1+			Additional information 40.
2658.0	2+	483	<2	2177.6	3+			
		906	<1	1754.4	3+			
		1335	<2	1323.2	2+			
		1511	<1	1149.8	1+			
		2147[@]	<10	512.9	0			
		2582[@]	22 *2*	78.2	2+			Additional information 41.
		2658	78 *2*	0	1+	M1(+E2)	+0.05 *16*	Additional information 42.
2746.0	1,2	527	<6	2218.9	2+			
		568	<7	2177.6	3+			
		992	<7	1754.4	3+			
		1422	<9	1323.2	2+			
		1597[@]	<10	1149.8	1+			
		2230[@]	74 *4*	512.9	0			
		2668[@&]		78.2	2+			
		2745	26 *4*	0	1+			
3005.4	3+	775	<1	2230	2+			

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^{29}Si(α,p),(α,pγ) 1976Va09 (continued)

$\gamma(^{32}P)$ (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[‡#]	δ[‡]	Comments
3005.4	3+	787	<2	2218.9	2+			
		828	4.0 *3*	2177.6	3+	M1+E2	−0.11 *16*	
		1682	4.4 *5*	1323.2	2+	M1+E2	−1.7 *8*	
		1856	<2	1149.8	1+			
		2493	<3	512.9	0			
		2927	84.9 *8*	78.2	2+			Mult.,δ: −0.09 *9* or −3.1 *+2−5* (1976Va09).
		3005	6.7 *6*	0	1+			
3149.3	4+	919	<1	2230	2+			
		931	<1	2218.9	2+			
		972[@]	20.2 *3*	2177.6	3+	M1+E2	+0.11[#] *4*	Additional information 43.
		1395[@]	13.4 *6*	1754.4	3+	E2+(M1)	+4.8[#] *12*	Additional information 44.
		1827[@]	59.4 *6*	1323.2	2+	E2(+M3)	−0.07[#] *7*	Additional information 45.
		2000	<0.5	1149.8	1+			
		2637	<0.4	512.9	0			
		3072[@]	7.1 *3*	78.2	2+	E2(+M3)	+0.05[#] *10*	Additional information 46.
		3149	<0.3	0	1+			
3260	2−	1032[@]	10.3 *9*	2230	2+			Additional information 47.
		1042	<3	2218.9	2+			
		1083	<3	2177.6	3+			
		1507[@]	11.7 *8*	1754.4	3+			E_γ: from 1973Ca18. Additional information 48.
		1937[@]	17.1 *11*	1323.2	2+			Additional information 49.
		2112[@]	44.1 *15*	1149.8	1+	E1(+M2)	+0.16[#] *18*	Additional information 50.
		2748	<2	512.9	0			
		3184[@]	14 *2*	78.2	2+			Additional information 51.
		3260	3.1 *9*	0	1+			
3320	3−	1090	<3	2230	2+			
		1102	<4	2218.9	2+			
		1566	<4	1754.4	3+			
		1997	25.5 *19*	1323.2	2+			
		2170	<3	1149.8	1+			
		2808	<4	512.9	0			
		3245[@]	74.5 *19*	78.2	2+	E1(+M2)	−0.02[#] *8*	
		3320	<3	0	1+			
3443		1213	<1.5	2230	2+			
		1225	<1.7	2218.9	2+			
		1266	6.0 *12*	2177.6	3+			
		1689	94.0 *12*	1754.4	3+			
		2294	<0.8	1149.8	1+			
		2931	<0.9	512.9	0			
		3365	<0.7	78.2	2+			
		3443	<0.6	0	1+			
3445.2	4−	1214	17 *3*	2230	2+			
		1226	<11	2218.9	2+			
		1267	<11	2177.6	3+			
		1690[@]	<5	1754.4	3+	E1(+M2)	−0.05[#] *3*	Additional information 52.
		2121	<7	1323.2	2+			
		2295	<8	1149.8	1+			
		2932	<10	512.9	0			
		3367[@]	44 *4*	78.2	2+			Additional information 53.
		3444	39 *5*	0	1+			Additional information 54.
3797.3		3718[@]		78.2	2+			
3800	3−	357.0	<4	3443				

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^{29}Si(α,p),(α,pγ) 1976Va09 (continued)

$\gamma(^{32}P)$ (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[‡#]	δ[‡]	Comments
3800	3$^-$	480.0	<5	3320	3$^-$			
		540.0	<4	3260	2$^-$			
		650.7	<4	3149.3	4$^+$			
		794.6	<7	3005.4	3$^+$			
		1140.0	<3	2658.0	2$^+$			
		1569.9	<4	2230	2$^+$			
		1581.0	<4	2218.9	2$^+$			
		1622.3	<4	2177.6	3$^+$			
		2045.5	<3	1754.4	3$^+$			
		2476.6	78.0 *12*	1323.2	2$^+$			
		2650.0	<2	1149.8	1$^+$			
		3286.7	<1	512.9	0			
		3721.4	22.0 *12*	78.2	2$^+$			
		3799.5	<1	0	1$^+$			
3881.0	2$^+$	3801.4	32 *5*	78.2	2$^+$	M1+E2	+0.6 *5*	
		3879.5	68 *5*	0	1$^+$			
3988.7		2235.4	<16	1754.4	3$^+$			
		3475[@&]	<24	512.9	0			I_γ: from 1973Ca18.
		3910[@]	>84	78.2	2$^+$			Additional information 55.
4010.0		747[@]	20 *10*	3260	2$^-$			Additional information 56.
		3929[@]	40 *15*	78.2	2$^+$			Additional information 57.
		4009.5	40 *15*	0	1$^+$			Additional information 58.
4034.6	4$^+$,(2$^+$)	2279.4	65 *2*	1754.4	3$^+$			
		3956.1	35 *2*	78.2	2$^+$			
4040.0		2890[@]	19 *2*	1149.8	1$^+$			Additional information 59. Mult.: M1.
		3527[@]	76 *3*	512.9	0			Additional information 60.
		3962[@]	5.1 *11*	78.2	2$^+$			Mult.,δ: −0.09 *9* or −10 *+4−20*. Additional information 61.
4148.8	3$^-$	1000.7	<9	3149.3	4$^+$			
		1143.0	<6	3005.4	3$^+$			
		1489.9	13.3 *10*	2658.0	2$^+$			
		1919.9	<7	2230	2$^+$			
		1931.0	10.8 *12*	2218.9	2$^+$			
		1972.3	<4	2177.6	3$^+$			
		2395.4	<3	1754.4	3$^+$			
		2826.5	<3	1323.2	2$^+$			
		2999.9	<3	1149.8	1$^+$			
		3636.7	<2	512.9	0			
		4070[@]	75.9 *14*	78.2	2$^+$	E1+M2	+0.12 *7*	Additional information 62.
		4149.4	<2	0	1$^+$			
4203		2022.3	<56	2177.6	3$^+$			
		4121.3	>44	78.2	2$^+$			
4275.2	5$^-$	829.8	77.0 *12*	3445.2	4$^-$	M1+E2	−0.14 *2*	
		955.0	<3	3320	3$^-$			
		1015.0	<3	3260	2$^-$			
		1125.7	23.0 *12*	3149.3	4$^+$	E1(+M2)	+0.07 *7*	
		1269.6	<5	3005.4	3$^+$			
		1619.9	<3	2658.0	2$^+$			
		2044.9	<3	2230	2$^+$			
		2056.0	<5	2218.9	2$^+$			
		2520.4	<2	1754.4	3$^+$			
		2951.5	<2	1323.2	2$^+$			
		3124.9	<2	1149.8	1$^+$			

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^{29}Si(α,p),(α,pγ) 1976Va09 (continued)

$\gamma(^{32}P)$ (continued)

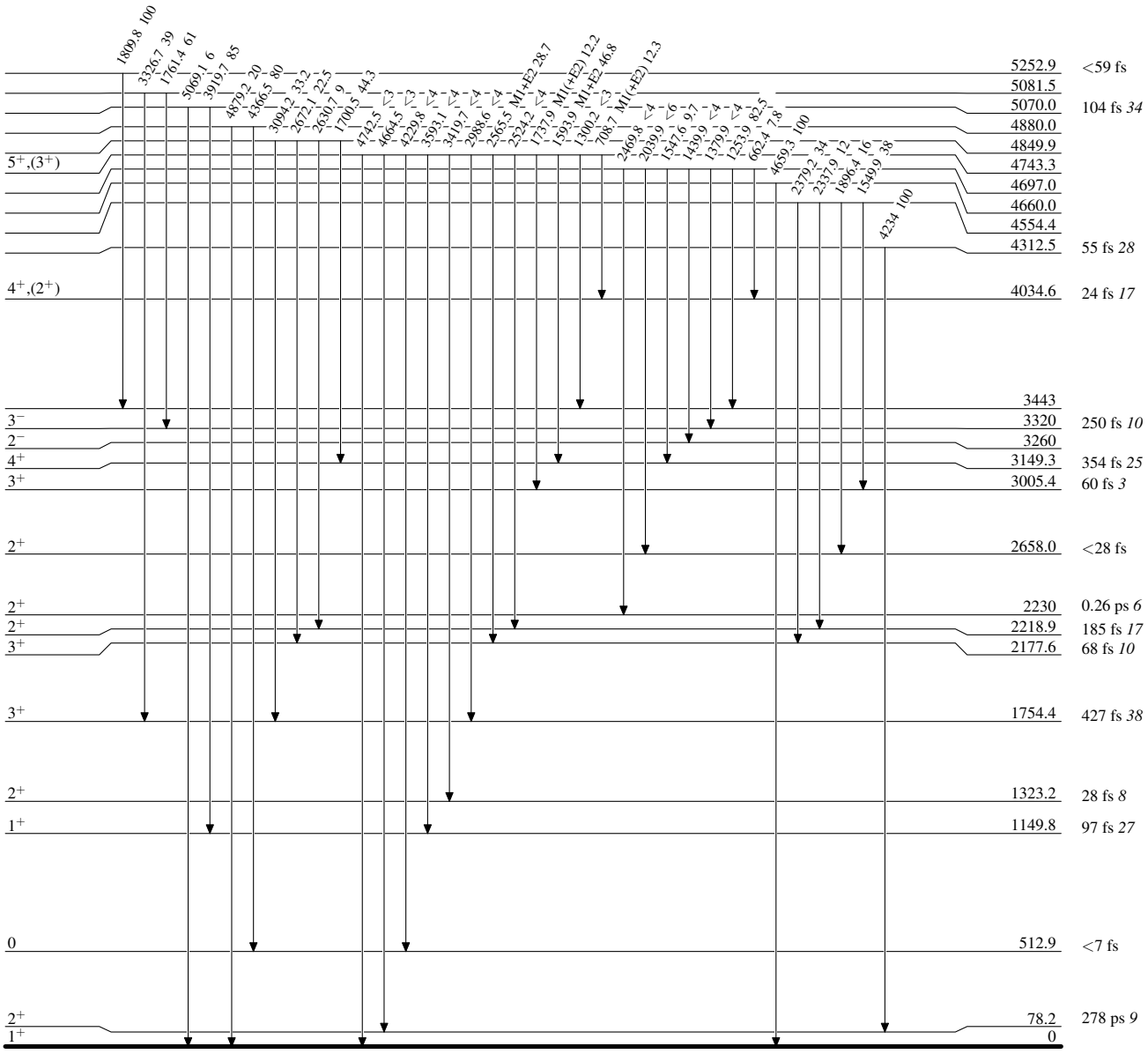
E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[‡#]	δ[‡]
4275.2	5^-	3761.6	<2	512.9	0		
		4196.3	<2	78.2	2^+		
		4274.4	<2	0	1^+		
4312.5		4234	100	78.2	2^+		
4554.4		1549.9	38 *2*	3005.4	3^+		
		1896.4	16 *2*	2658.0	2^+		
		2337.9	12 *2*	2218.9	2^+		
		2379.2	34 *2*	2177.6	3^+		
4660.0		4659.3	100	0	1^+		
4697.0		662.4	7.8 *6*	4034.6	4^+,(2^+)		
		1253.9	82.5 *10*	3443			
		1379.9	<4	3320	3^-		
		1439.9	<4	3260	2^-		
		1547.6	9.7 *9*	3149.3	4^+		
		2039.9	<6	2658.0	2^+		
		2469.8	<4	2230	2^+		
4743.3	5^+,(3^+)	708.7	12.3 *7*	4034.6	4^+,(2^+)	M1(+E2)	−0.03 *5*
		1300.2	<3	3443			
		1593.9	46.8 *13*	3149.3	4^+	M1+E2	−0.12 *4*
		1737.9	12.2 *11*	3005.4	3^+	M1(+E2)	−0.06 *6*
		2524.2	<4	2218.9	2^+		
		2565.5	28.7 *11*	2177.6	3^+	M1+E2	−0.08 *5*
		2988.6	<4	1754.4	3^+		
		3419.7	<4	1323.2	2^+		
		3593.1	<4	1149.8	1^+		
		4229.8	<4	512.9	0		
		4664.5	<3	78.2	2^+		
		4742.5	<3	0	1^+		
4849.9		1700.5	44.3 *12*	3149.3	4^+		
		2630.7	9 *1*	2218.9	2^+		
		2672.1	22.5 *10*	2177.6	3^+		
		3094.2	33.2 *11*	1754.4	3^+		
4880.0		4366.5	80 *4*	512.9	0		
		4879.2	20 *4*	0	1^+		
5070.0		3919.7	85 *2*	1149.8	1^+		
		5069.1	6 *1*	0	1^+		
5081.5		1761.4	61 *3*	3320	3^-		
		3326.7	39 *3*	1754.4	3^+		
5252.9		1809.8	100	3443			

[†] From energy level differences as proposed in 1973Va14 for levels below 3797 keV, and from 1976Va09 for levels above 3797 keV, unless otherwise noted.
[‡] From 1976Va09, unless otherwise noted.
[#] From 1973Va14.
[@] From 1973Ca18.
[&] Placement of transition in the level scheme is uncertain.

^{29}Si(α,p),(α,pγ) **1976Va09**

Level Scheme

Intensities: % photon branching from each level

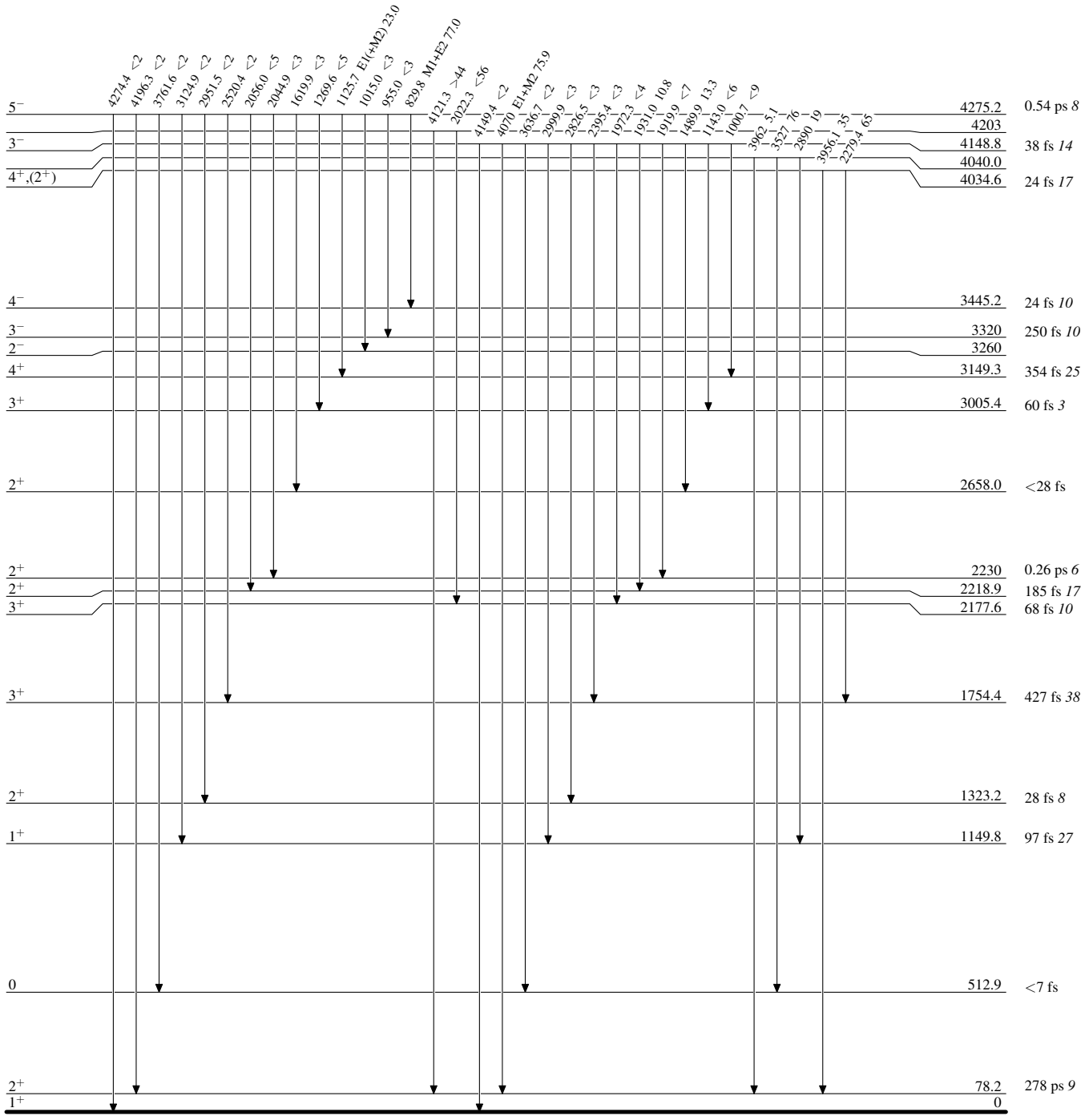


$^{32}_{15}P_{17}$

^{29}Si(α,p),(α,pγ) 1976Va09

Level Scheme (continued)

Intensities: % photon branching from each level



$^{32}_{15}P_{17}$

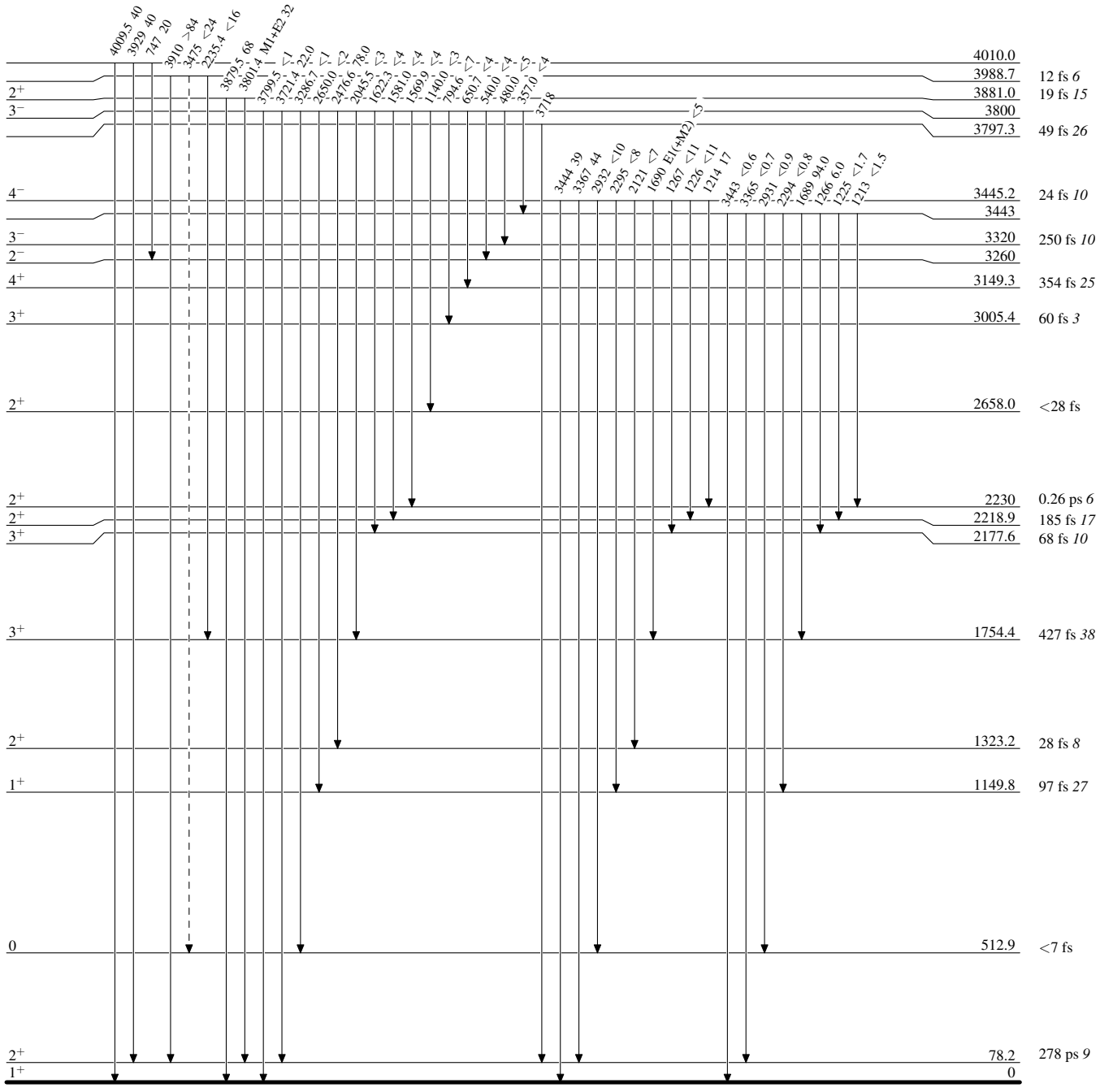
^{29}Si(α,p),(α,pγ) **1976Va09**

Legend

Level Scheme (continued)

Intensities: % photon branching from each level

γ Decay (Uncertain)



$^{32}_{15}P_{17}$

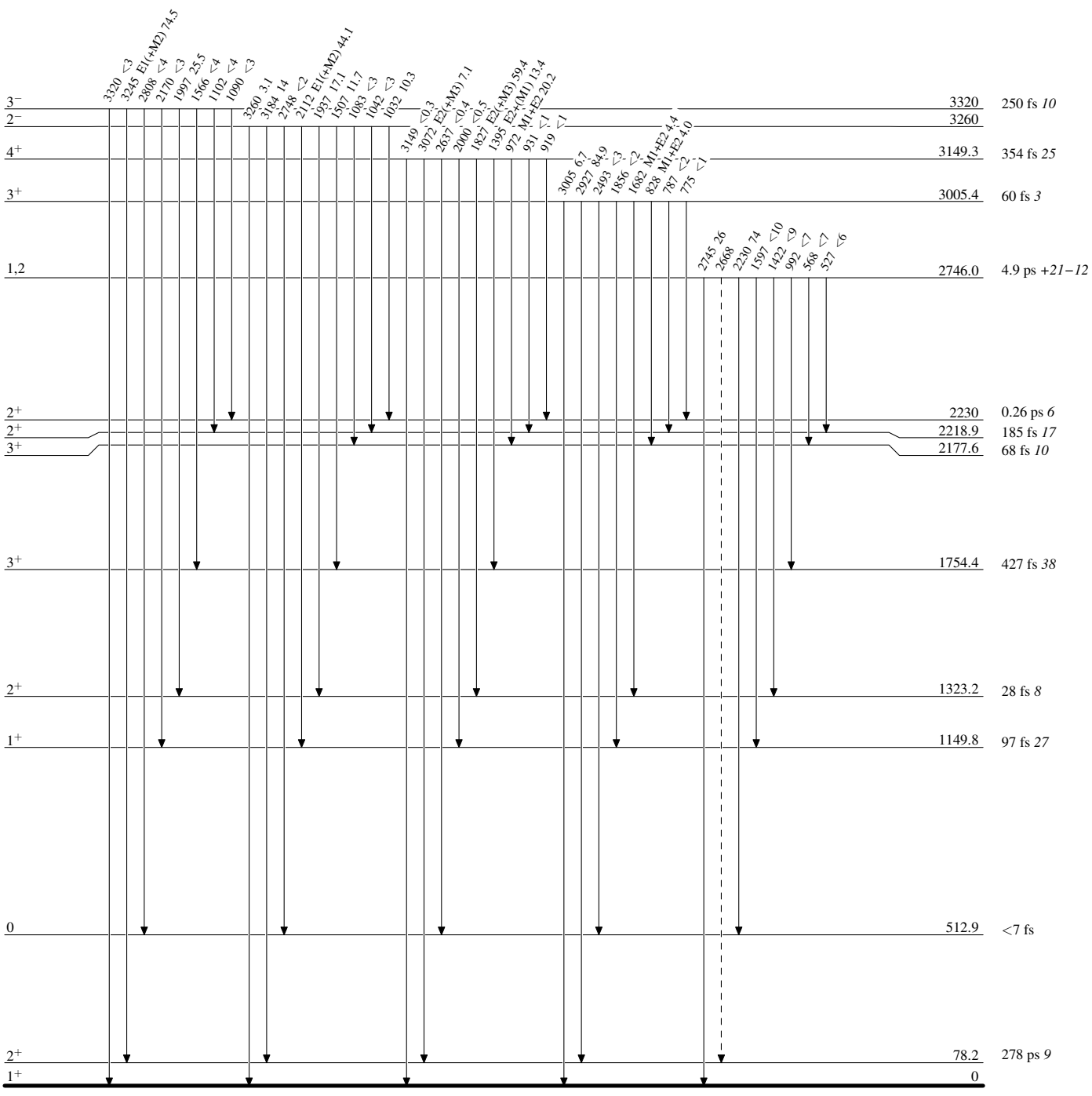
^{29}Si(α,p),(α,pγ) 1976Va09

Legend

Level Scheme (continued)

Intensities: % photon branching from each level

γ Decay (Uncertain)

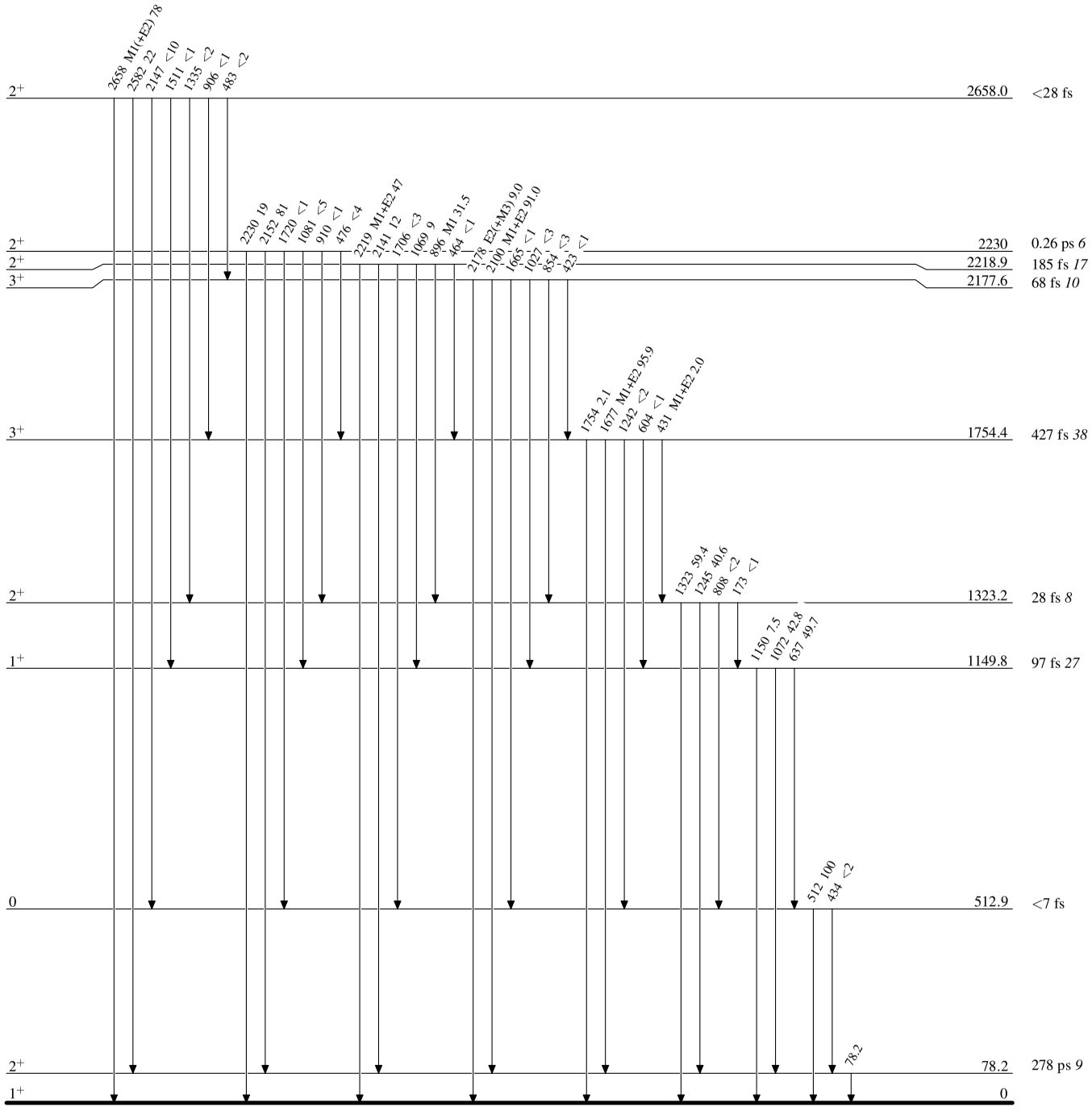


$^{32}_{15}P_{17}$

^{29}Si(α,p),(α,pγ) 1976Va09

Level Scheme (continued)

Intensities: % photon branching from each level



$^{32}_{15}P_{17}$