^{41}Ca(p,γ) 1989Ki11

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Jun Chen[#] and Balraj Singh	NDS 135, 1 (2016)	31-May-2016

1989Ki11: E=1.7-2.1 MeV proton beam was produced at the Utrecht 3 MV Van de Graaff accelerator with currents of 20-40 μA and energy spread of 200 eV at 1 MeV. Targets of a 12 mg $CaCO_3$ enriched to 81.7 in ^{41}Ca. Two close-end hyperpure Ge(HPGe) detectors for γ-ray detection, FWHM=1.72 and 1.81 keV at 1.332 MeV. Measured Eγ, Iγ. Deduced levels, branching ratios, lifetimes by DSAM.

S(p)(^{42}Sc)=4272.40 15 deduced from E_x and E_p(lab) of the E_x=S(p)+E_p(c.m.)=6076.41 keV resonance with E_p (1989Ki11). S(p)=4272.23 *10* from 2012Wa38.

^{42}Sc Levels

Resonance strength=(2J+1)$\Gamma_p\Gamma_\gamma/\Gamma$ (1989Ki11).

E(level)[†]	Jπ[a]	$T_{1/2}$	Comments
0	0^+		
611.051 *5*	1^+		
616.28 *6*	7^+[b]		
1490.43 *4*	3^+		
1510.10 *6*	5^+		
1586.31 *2*	2^+		
1846	$3^{(+)}$		
1874	0^+		
1890	1^+		
2187.54 *5*	3^+		Measured upper limit of branching <2% for γ to g.s.
2223.15 *3*	3^+	>0.21 ps	Measured upper limit of branching <2% for γ to g.s.
2269.13 *3*	2^+	>70 fs	
2389.06 *5*	3^+		
2433.33 *8*	4^+	>0.14 ps	Measured upper limit of branching <2% for γ to 1890, 1^+, <2% for γ to 611, 1^+, and <4% to 616, 7^+.
2486.59 *13*	2^+		
2587	(2,4)		
2650.98 *8*	(1^+,2)	35 fs *21*	
2795.3 *3*	(5^+,6^+)[c]		
2815.37 *6*	4^+	35 fs *14*	
2847.6 *4*	3^+		
2910.4 *4*	4^+		
2995.53 *7*	4^+	>0.14 ps	Measured upper limit of branching <6% for γ to 1890, 1^+, and <10% to 616, 7^+.
3022.80 *15*	4^-		
3089.1 *3*	5^+	>0.14 ps	
3223.28 *6*	(5^+)	>0.21 ps	Measured upper limit of branching <3% for γ to 1890, 1^+, and <4% to 611, 1^+.
3321.36 *10*	(1^+,2,3^+)	>0.14 ps	
3322.8 *3*	(3^+,4,5^+)	<35 fs	
3668.7 *3*			
3719.3 *4*	$(5)^+$	>70 fs	
4047.72 *6*	(2,3,4)	<14 fs	
4468.8 *4*	$(2,3)^+$		
5995.8[‡] *3*	$(3,4)^+$		
6076.41[#] *8*	(2^+,3,4^+)		
6174.2[@] *3*	$(3,4)^+$		
6253.4[&] *2*	(3^+,4)		

Continued on next page (footnotes at end of table)

$^{41}Ca(p,\gamma)$ 1989Ki11 (continued)

^{42}Sc Levels (continued)

† From 1989Ki11, deduced from γ energies.
‡ E(p)(lab)=1765.8 *3*. Resonance strength=3.3 eV *8*. 21% 5 of the decay occurs through unknown transitions.
# E(p)(lab)=1848.41 *12*. Resonance strength=0.7 eV *2*. 6% 2 of the decay occurs through unknown transitions.
@ E(p)(lab)=1948.6 *3*. Resonance strength=5.5 eV *14*. 18% 5 of the decay occurs through unknown transitions.
& E(p)(lab)=2029.8 *3*. Resonance strength=1.5 eV *4*. 14% 5 of the decay occurs through unknown transitions.
[a] From Adopted Levels. For resonances, the assignments are based based on decay modes, assuming E1, M1 or E2 transitions.
[b] 5^+ and 6^+ are not completely ruled out, but 7^+ is generally accepted from theoretical predictions.
[c] 1989Ki11 give (5,6,7).

$\gamma(^{42}Sc)$

E_i(level)	J^π_i	E_γ†	I_γ‡	E_f	J^π_f	Comments
611.051	1^+	611.046 *6*		0	0^+	
1490.43	3^+	879.37	100	611.051	1^+	Iγ<1 for gammas to 616 and g.s..
1510.10	5^+	893.81	100	616.28	7^+	Iγ<1 for γ to g.s.; Iγ<4 for γ to 611.
1586.31	2^+	975.25 *3*	100 *11*	611.051	1^+	
		1586.28	9.5 *11*	0	0^+	Iγ<1 for γ to 616.
1846	$3^{(+)}$	260		1586.31	2^+	
		1235		611.051	1^+	
1874	0^+	1263	100	611.051	1^+	Iγ<8 for gammas to 616 and g.s..
1890	1^+	1890	100	0	0^+	
2187.54	3^+	601.23	95 *2*	1586.31	2^+	
		677.4#	<2	1510.10	5^+	
		697.1#	<2	1490.43	3^+	
		1576.46	5 *2*	611.051	1^+	
2223.15	3^+	636.833 *9*	95 *2*	1586.31	2^+	
		713.0#	<2	1510.10	5^+	
		732.71	5 *2*	1490.43	3^+	
		1612.1#	<2	611.051	1^+	
2269.13	2^+	379.13	6 *3*	1890	1^+	
		682.808 *23*	52 *5*	1586.31	2^+	
		778.7#	<5	1490.43	3^+	
		1658.04	22 *6*	611.051	1^+	
		2269.06	20 *4*	0	0^+	Iγ<3 for γ to 1510; Iγ<1 for γ to 616.
2389.06	3^+	543.1#	<2	1846	$3^{(+)}$	
		802.7#	<2	1586.31	2^+	
		878.95	88 *4*	1510.10	5^+	
		898.62	12 *4*	1490.43	3^+	
		1778.0#	<4	611.051	1^+	Iγ<3 for γ to 616; Iγ<4 for γ to g.s..
2433.33	4^+	847.0#	<2	1586.31	2^+	
		923.22	48 *3*	1510.10	5^+	
		942.89	52 *3*	1490.43	3^+	
2486.59	2^+	596.6#	<4	1890	1^+	
		612.6#	<5	1874	0^+	
		640.6#	<5	1846	$3^{(+)}$	
		900.3#	<4	1586.31	2^+	
		996.15	23 *5*	1490.43	3^+	
		1875.49	77 *5*	611.051	1^+	
		2486.5#	<10	0	0^+	Iγ<5 for γ to 616 and γ to 1510.
2587	(2,4)	1097		1490.43	3^+	

Continued on next page (footnotes at end of table)

$^{41}Ca(p,\gamma)$ 1989Ki11 (continued)

$\gamma(^{42}Sc)$ (continued)

E_i(level)	J_i^π	E_γ†	I_γ‡	E_f	J_f^π	Comments
2650.98	$(1^+,2)$	760.97	10 *3*	1890	1^+	
		777.0#	<3	1874	0^+	
		805.0#	<3	1846	$3^{(+)}$	
		1064.66	90 *3*	1586.31	2^+	
		1160.5#	<3	1490.43	3^+	
		2039.9#	<3	611.051	1^+	
		2650.9#	<3	0	0^+	$I\gamma<2$ for γ to 616; $I\gamma<3$ for γ to 1510.
2795.3	$(5^+,6^+)$	2179.0	100	616.28	7^+	
2815.37	4^+	592.2#	<2	2223.15	3^+	
		627.8#	<2	2187.54	3^+	
		969.36	5 *3*	1846	$3^{(+)}$	
		1305.25	61 *3*	1510.10	5^+	
		1324.92	34 *2*	1490.43	3^+	$I\gamma<1$ for gammas to g.s., 611 and 616; $I\gamma<4$ for γ to 1874; $I\gamma<2$ for γ to 1890.
2847.6	3^+	1261.3		1586.31	2^+	
2910.4	4^+	1419.9		1490.43	3^+	
2995.53	4^+	606.47	20 *10*	2389.06	3^+	
		772.37	80 *10*	2223.15	3^+	
		808.0#	<6	2187.54	3^+	
		1149.5#	<4	1846	$3^{(+)}$	
		1485.4#	<5	1510.10	5^+	$I\gamma<3$ for γ to g.s.; $I\gamma<7$ for γ to 1874; $I\gamma<2$ for γ to 1890.
3022.80	4^-	1512.67	100	1510.10	5^+	
3089.1	5^+	2472.7	100	616.28	7^+	
3223.28	(5^+)	834.21	41 *3*	2389.06	3^+	
		1000.12	32 *8*	2223.15	3^+	
		1035.7#	<8	2187.54	3^+	
		1377.3#	<5	1846	$3^{(+)}$	
		1713.14	27 *3*	1510.10	5^+	
		1732.8#	<6	1490.43	3^+	
		2606.9#	<2	616.28	7^+	$I\gamma<4$ for γ to g.s.; $I\gamma<5$ for γ to 1874.
3321.36	$(1^+,2,3^+)$	1098.2#	<6	2223.15	3^+	
		1133.8#	<6	2187.54	3^+	
		1431.3#	<4	1890	1^+	
		1447.3#	<8	1874	0^+	
		1475.3#	<8	1846	$3^{(+)}$	
		1811.2#	<6	1510.10	5^+	
		1830.89	50 *10*	1490.43	3^+	
		2710.22	50 *10*	611.051	1^+	
		3321.2#	<5	0	0^+	$I\gamma<4$ for γ to 616.
3322.8	$(3^+,4,5^+)$	1099.6#	<3	2223.15	3^+	
		1135.2#	<8	2187.54	3^+	
		1476.8#	<3	1846	$3^{(+)}$	
		1812.7	57 *5*	1510.10	5^+	
		1832.3	43 *5*	1490.43	3^+	
		2706.4#	<4	616.28	7^+	$I\gamma<5$ for γ to g.s.; $I\gamma<4$ for γ to 611; $I\gamma<3$ for gammas to 1874 and 1890.
3668.7		1235.4		2433.33	4^+	
		1445.5		2223.15	3^+	
3719.3	$(5)^+$	1496.1#	<2	2223.15	3^+	

Continued on next page (footnotes at end of table)

^{41}Ca(p,γ) 1989Ki11 (continued)

γ(^{42}Sc) (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[‡]	E_f	J^π_f	Comments
3719.3	(5)$^+$	1531.7[#]	<7	2187.54	3$^+$	
		1873.3[#]	<4	1846	3$^{(+)}$	
		2209.1[#]	<4	1510.10	5$^+$	
		2228.8[#]	<6	1490.43	3$^+$	
		3102.9	100	616.28	7$^+$	Iγ<2 for gammas to g.s., 611, 1590 and 1874.
4047.72	(2,3,4)	1658.63	≈50	2389.06	3$^+$	50% of the decay from 4048 level proceeds through unknown transitions.
4468.8	(2,3)$^+$	1558.4	25 *5*	2910.4	4$^+$	
		2882.4	25 *2*	1586.31	2$^+$	50% of the decay from 4048 level proceeds through unknown transitions.
5995.8	(3,4)$^+$	1948.0	6 *2*	4047.72	(2,3,4)	
		2772.4	13 *2*	3223.28	(5$^+$)	
		2906.6	3 *1*	3089.1	5$^+$	
		2972.9	≈1	3022.80	4$^-$	
		3148.1	4 *1*	2847.6	3$^+$	
		3180.3	3 *1*	2815.37	4$^+$	
		3344.7	4 *1*	2650.98	(1$^+$,2)	
		3509.1	3 *1*	2486.59	2$^+$	
		3562.3	3 *1*	2433.33	4$^+$	
		3772.5	6 *2*	2223.15	3$^+$	
		3808.1	2 *1*	2187.54	3$^+$	
		4409.2	8 *2*	1586.31	2$^+$	
		4485.4	16 *2*	1510.10	5$^+$	
		4505.1	7 *2*	1490.43	3$^+$	
6076.41	(2$^+$,3,4$^+$)	2028.6	4 *1*	4047.72	(2,3,4)	
		2407.6	4 *1*	3668.7		
		2755.0	10 *2*	3321.36	(1$^+$,2,3$^+$)	
		3053.5	7 *2*	3022.80	4$^-$	
		3165.9	4 *1*	2910.4	4$^+$	
		3687.2	17 *2*	2389.06	3$^+$	
		3807.14 *8*	21 *2*	2269.13	2$^+$	
		3853.06 *8*	29 *2*	2223.15	3$^+$	
6174.2	(3,4)$^+$	1705.4	4 *1*	4468.8	(2,3)$^+$	
		2454.8	20 *2*	3719.3	(5)$^+$	
		2851.3	8 *2*	3322.8	(3$^+$,4,5$^+$)	
		2950.8	7 *2*	3223.28	(5$^+$)	
		3085.0	3 *1*	3089.1	5$^+$	
		3178.5	7 *2*	2995.53	4$^+$	
		3358.7	9 *2*	2815.37	4$^+$	
		3378.8	3 *1*	2795.3	(5$^+$,6$^+$)	
		3904.9	21 *2*	2269.13	2$^+$	
6253.4	(3$^+$,4)	3164.2	4 *1*	3089.1	5$^+$	
		3405.7	4 *1*	2847.6	3$^+$	
		3437.9	3 *1*	2815.37	4$^+$	
		3602.3	15 *2*	2650.98	(1$^+$,2)	
		3819.9	15 *2*	2433.33	4$^+$	
		4030.0	≈1	2223.15	3$^+$	
		4065.6	30 *2*	2187.54	3$^+$	
		4743.0	7 *2*	1510.10	5$^+$	
		4762.7	7 *2*	1490.43	3$^+$	

† Values without uncertainties are from level-energy differences.

Continued on next page (footnotes at end of table)

^{41}Ca(p,γ) 1989Ki11 (continued)

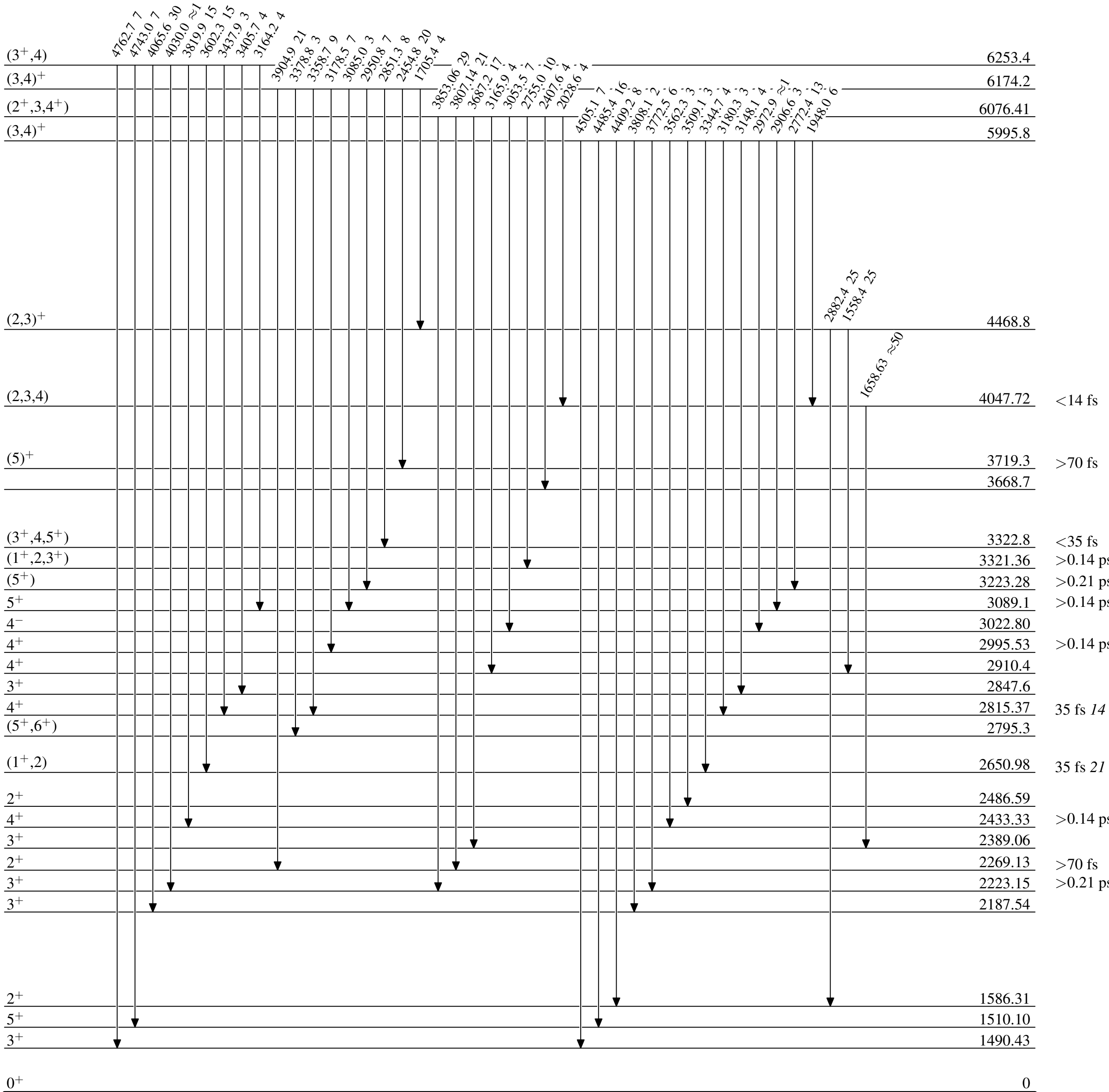
γ(^{42}Sc) (continued)

‡ Upper limits on branching ratio for transitions involving ΔJ>2 are given under comments (1989Ki11).
# Placement of transition in the level scheme is uncertain.

^{41}Ca(p,γ) 1989Ki11

Level Scheme

Intensities: % photon branching from each level



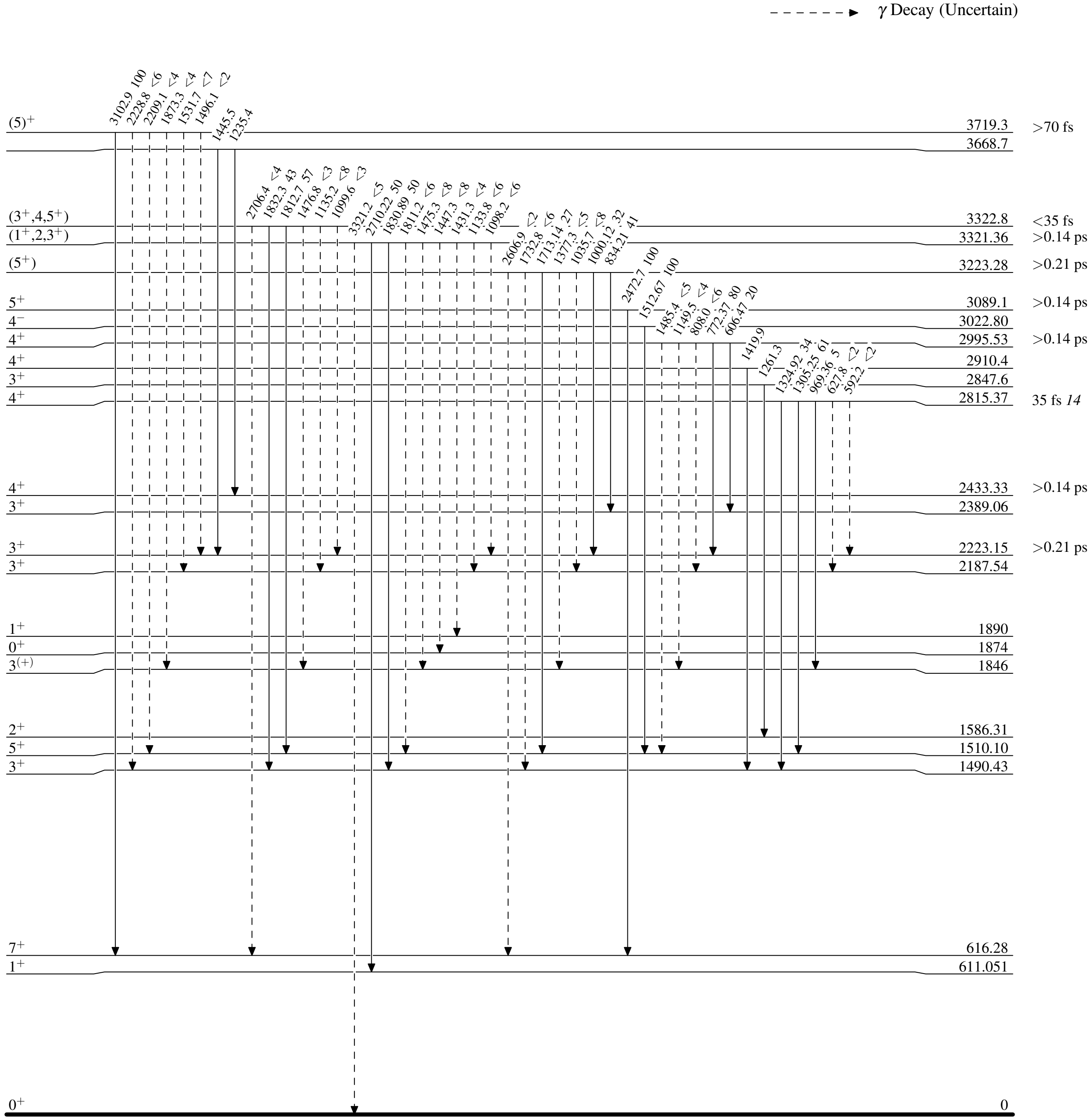
$^{42}_{21}Sc_{21}$

^{41}Ca(p,γ) 1989Ki11

Legend

Level Scheme (continued)

Intensities: % photon branching from each level



$^{42}_{21}Sc_{21}$

^{41}Ca(p,γ) 1989Ki11

Level Scheme (continued)

Intensities: % photon branching from each level