Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	M. Shamsuzzoha Basunia, Anagha Chakraborty	NDS 186, 2 (2022)	31-Mar-2022

Q(β^-)=5515.677 *21*; S(n)=6959.365 *17*; S(p)=10552.83 *11* 2021Wa16
Q(α)=−10825.35 *3*, S(2n)=19379.15 *13*, S(2p)=25789 *12* (2021Wa16).
Other reactions:
1988Ja04: ^{24}Mg(n,p), neutron from D-T reaction with E_d=0.44 to 1.8 MeV. Pure metallic ^{24}Mg and ^{27}Al targets. NaI(Tl) detector. Measured cross-section by activation technique.
1971Ki09: ^{25}Mg(p,2p): Thin and high purity (99.5% enrichment) target. Recoil catcher. Measured recoil spectra at 60° and 90° for an incident beam energy of 300 MeV. All the spectra exhibited two distinct peaks.

^{24}Na Levels

Note: π=N stands for natural, U for unnatural.

Cross Reference (XREF) Flags

A	^{24}Ne β^- decay (3.38 min)	F	^{23}Na(n,γ) E=thermal	K	^{23}Na(pol d,p)
B	^{24}Na IT decay (20.18 ms)	G	^{23}Na(n,γ) E=10-80 keV	L	^{24}Mg(d,^{2}He)
C	^{10}B(^{16}O,2pγ)	H	^{23}Na(n,γ) E=53 keV	M	^{24}Mg(t,^{3}He)
D	^{22}Ne(^{3}He,p),(^{3}He,pγ)	I	^{23}Na(d,p)	N	^{25}Mg(d,^{3}He),(^{11}B,^{12}C)
E	^{22}Ne(α,d)	J	^{23}Na(d,pγ)	O	^{26}Mg(d,$\alpha\gamma$),(pol d,α)

E(level)[†]	J^{π}[@]	$T_{1/2}$[&]	XREF	Comments
0.0	4$^+$	14.956[a] h *3*	ABCDEFG IJK NO	%β^-=100 μ=+1.6903 *8* <r^2>$^{1/2}$(^{24}Na)=2.974 fm *17* (charge radius) (2013An02). J^{π}: Atomic beam laser spectroscopy (1978Hu12), 1514.7γ M1+E2 from π=+ level. $T_{1/2}$: Weighted average of 14.951 h *3* [Erratum of 2014Un01 – superseded 14.955 h *7* (2014Un01), 14.951 h *3* (2012Fi12), 14.9512 h *32* (2004Un01), 14.951 h *3* (2002Un02), 14.9512 h *32* (1992Un01) – all from same lab], 14.959 h *9* (2005Li66), 14.90 h *2* (1991Bo34), 14.9575 h *28* (1983Wa26), 14.956 h *3* [in 1982La25 with 3σ uncertainty=8, this value superseded 15.00 h *2* (1968La10)], 14.965 h *10* [1980RuZY,1982RuZV,1982HoZJ using 4π proportional counter – also another value 14.959 h *1* was reported using ioniation chamber – no details for this better precision was noted. One value is considered from this group with caution], 14.964 h *15* (1980Mu11), 14.969 h *12* (1974Ch25), 14.953 h *13* (1960Wo07), 14.959 h *10* (1958Ca20), 14.90 h *5* (1955To07), 14.97 h *2* (1953Lo09), and 14.90 h *2* (1949Wi15). Other values: 14.86 h *12* (1994Mi03 – measurement duration 1.5 half-life), 15.027 h *2* (1989Ab05), 14.9590 h *12* (1980Ho17 – poor documentation), 15.010 h *28* (1978Da21), 15.09 h *6* (1976Ge06), 15.030 h *3* [1972Em01 – superseded 15.05 h *2* (1961Wy01)], 15.04 h *5* (1962Mo21 – also 15.05 h *5*), 15.10 h *4* (1950Co69), 15.16 h *5* (1969Ke14), and 15.04 h *6* (1950So55). See footnote. μ: From 1966Ch15, 1973CoZG, 2019StZV (Atomic beam magnetic resonance).
472.2071 *14*	1$^+$	20.18 ms *10*	ABCDEFGHIJKLMNO	%IT≈99.95; %β^-≈0.05 μ=−1.931 *3* %β^-: Estimated value in 1956Dr11, 1980He08.

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Adopted Levels, Gammas (continued)

^{24}Na Levels (continued)

E(level)[†]	J$^{\pi}$[@]	T$_{1/2}$[&]	XREF	Comments
				J$^{\pi}$: log *ft*=4.4, from 0^+ level. For a millisecond range isomer, 472γ transition of ΔJ=3 to 4^+ g.s. is expected (1956Dr11 – ^{24}Ne β^- decay). Unnatural parity (pol d,α). T$_{1/2}$: Weighted average of 19.9 ms *3* (1961Sc09), 20.1 ms *2* (1970Ch37), 20.21 ms *14* (1972Br53) and 20.22 ms *10* (1980Jo11) – All in ^{24}Na IT decay (20.18 ms). Other: 5 ms < T$_{1/2}$ < 50 ms and a most probable value of 20 ms (1956Dr11 – ^{24}Ne β^- decay (3.38 min)). μ: From 1980He08, 2019StZV (β-nuclear magnetic resonance).
563.1993 *20*	2^+	35 ps *5*	CD FGHIJK NO	J$^{\pi}$: L=0(+2) in (d,p), γ to 4^+ and RUL. T$_{1/2}$: weighted average of 32 ps *4* from (^{16}O,2pγ) and 43 ps *6* from (d,$\alpha\gamma$).
1341.438 *14*	2^+	50 fs *13*	d FGH JK nO	J$^{\pi}$: L=0+2 in (pol d,p) for triplet, γ's to 1^+ and 4^+ levels, π=N (pol d,α). T$_{1/2}$: weighted average of 97 fs *35* from (^{3}He,p) and 46 fs *10* from (d,p).
1344.648 *10*	$3^{(+)}$	26 fs *8*	d FGH J nO	J$^{\pi}$: D+Q [listed as (M1+E2) in the dataset for transition strength calculations] γ's to 2^+ and 4^+, parity from L=0+2 in (pol d,p) for triplet. Also spin 3 from shell model calculations (1984Ti01).
1346.635 *11*	1^+	4.4 ps *3*	A d FGH JKLMnO	J$^{\pi}$: log *ft*=4.40 from 0^+.
1513.7 *3*	5^+	27 fs *6*	DEFG JK NO	J$^{\pi}$: L=2 in (d,^{3}He), L=4 in (^{3}He,p), π=U in (pol d,α) gives 3^+,5^+. 3^+ excluded based on missing population by primary γ in (n,γ) from the 1^+,2^+ capture state. Also spin 5 from shell model calculations (1984Ti01). T$_{1/2}$: weighted average of 26 fs *8* from (d,p) and 28 fs *6* from (^{3}He,pγ).
1846.026 *10*	2^+	171 fs *35*	D FGHIJK NO	J$^{\pi}$: L=0(+2) in (d,p), L=2 in (^{3}He,p), π=N in (pol d,α). T$_{1/2}$: weighted average of 215 fs *49* from (^{3}He,pγ), 180 fs *35* and 139 fs *35* – both from (d,pγ). Uncertainty is the lower input value.
1885.537 *12*	3^+	26 fs *6*	DEFG IJKL NO	J$^{\pi}$: L=2 in (α,d), γ to 4^+, π=U in (pol d,α). T$_{1/2}$: weighted average of 28 fs *7* from (^{3}He,pγ) and 25 fs *6* from (d,pγ). Uncertainty lower input value.
2513.37 *4*	3^+	10 fs *5*	DEFGHIJK NO	J$^{\pi}$: L=2 in (α,d), γ to 4^+, π=U in (pol d,α).
2563.06 *21*	4^+	<17 fs	D FG IJK NO	J$^{\pi}$: L=2 in (d,p), π=N (pol d,α), γ to 5^+ level. Also spin 4 from shell model calculations (1984Ti01).
2903.935 *22*	3^+	35[b] fs *8*	DEFGH JK NO	J$^{\pi}$: L=0 in (d,^{3}He) and L=2 in (α,d), M1(+E2) γ to 4^+, γ to 1^+.
2977.776 *18*	2^+	<17 fs	D F HIJK NO	J$^{\pi}$: L=0+2 in (pol d,p), L=2 in (d,^{3}He), γ's to 1^+ and 4^+ levels. Also spin 2 from shell model calculations (1984Ti01).
3216.08 *19*	$(4)^+$	15 fs *6*	D FG IJK NO	J$^{\pi}$: L=2 in (d,^{3}He), π=N in (pol d,α), large value of δ for J=3 assignment (1974Ke12) gives 4^+,2^+. Spin 4 from shell model calculations (1984Ti01).
3371.830 *22*	2^-	13 fs *3*	D FGHIJK NO	J$^{\pi}$: L=1 in (pol d,p) and vector analyzing power, π=U in (pol d,α), and γ to 3^+.
3413.278 *23*	1^+	<14[b] fs	D FGHIJKL NO	J$^{\pi}$: L=0 in (^{3}He,p), π=U (pol d,α).
3589.31 *3*	1^+	<6[b] fs	DEFGHIJKL O	XREF: E(3600). J$^{\pi}$: L=0(+2) in (d,p), L=2 in (α,d), 0+2 in (^{3}He,p), and π=U in (pol d,α).
3628.18 *7*	3^+	<14[b] fs	D FGHIJK MNO	J$^{\pi}$: L=2 in (d,p), π=U in (pol d,α), γ to 4^+ and 1^+ levels.
3655.84 *5*	$(2^+,1^+,3^+)$	<14 fs	FGHIJK N	J$^{\pi}$: L=2 in (d,p). γ's to 3^+ and 1^+ levels. 2 from shell model calculations (1984Ti01).
3681.78 *5*	0^+	<14[b] fs	D F JK O	J$^{\pi}$: L=0 in (^{3}He,p), π=N in (pol d,α).
3737.62? *22*	$2^+,3^+,4^+$		K	J$^{\pi}$: L=2+4 in (pol d,p).

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Adopted Levels, Gammas (continued)

^{24}Na Levels (continued)

E(level)[†]	J^π[@]	$T_{1/2}$[&]	XREF	Comments
3745.04 *4*	3⁻	<17 fs	D FG IJK NO	J^π: L=3 in (d,p) and (^{3}He,p), π=N in (pol d,α), γ to 4⁺ and 2⁻.
3865.69 *10*			D F	
3884.85[‡] *32*			K N	
3898			E H	E(level): Average of 3900 (α,d) and 3996.1 (n,γ) E=53 KeV.
3933.58 *6*	(1⁺,2⁺,3)	<17[b] fs	D FGHiJKL N	XREF: G(3928.0). J^π: γ to 2⁺ and 3⁺; weak primary γ from 1⁺,2⁺ capture state (n,γ). L=1+3 in (d,p) and L=2 in (pol d,p) are inconsistent.
3943.66 *7*	(2⁺)	<14 fs	FGHiJK	J^π: L=2 in (pol d,p) and γ to 1⁺ and 4⁺ suggest spin 2⁺,3⁺; γ from (1⁻). But L=1+3 in (d,p) suggest π=−.
3977.33 *3*	1⁻	<14[b] fs	D F HiJK NO	J^π: L=1 in (d,p), π=N in (pol d,α), γ to 1⁺, 3⁻ ruled out by RUL. L=(0+2) in (^{3}He,p).
4048.83 *14*	(0,1,2)⁻		F K	J^π: L=1 in (pol d,p), γ to 1⁺, weaker population from 1⁺,2⁺ capture state in (n,γ). 2014Fi01 (n,γ) noted to reexamine the 0⁺ assignment proposed in earlier evaluations (1990En08, 2007Fi02).
4143.21 *16*	(4⁺)	<21 fs	DEF IJK NO	J^π: L=4 in (^{3}He,p), γ to 2⁺, and no primary feeding from 1⁺,2⁺ capture state in (n,γ) thermal (2014Fi01). L=5 in (α,d) presumably erroneous. Tentative π=(U) in (pol d,α) supports a (3⁺), but not supported by primary γ in (n,γ) thermal (2014Fi01).
4185.7 *4*	(1,3)⁺	<14 fs	d F IJK o	J^π: L=2 in (pol d,p) and π=(U) in (pol d,α) at 4190 probably for doublet.
4196.18 *7*	(2)⁻	<17 fs	d FG IJK No	J^π: L=1+3 based on measured dσ/dΩ (10° to 90°) and DWBA in (d,p) 1963Da06; γ to 3⁺; π=(U) (pol d,α) at 4190 − probably for doublet − the evaluators assume π=(U) (pol d,α) at 4190 is applicable for one of the doublets and it has been used for the J^π of 4185.7 keV level. 1⁻,2⁻ from L=1 based on measured dσ/dΩ (12° to 50°) in (pol d,p) (2004To03 − not shown in Fig.). The parity for J^π=(2⁺) from weaker primary γ feeding from 1⁺,2⁺ capture state in (n,γ) (2014Fi01) is not consistent for L=1+3. The reason is not clear.
4207.143 *16*	(2)⁻	<35 fs	F JK o	J^π: L=1+3 in (d,p); γ to 3⁺; L=1 in (pol d,p). strong primary γ feeding from 1⁺,2⁺ capture state in (n,γ); π=N (pol d,α) − probably for a doublet.
4220.6 *8*			J o	
4441.641 *18*	2⁻		D F I K NO	J^π: L=1 in (pol d,p); π=U in (pol d,α); L=1+3 in (d,p).
4468 *8*			O	
4526.87[‡] *24*	3⁻		D HI K NO	E(level): Other: 4525.9 (n,γ) E=53 keV. J^π: L=3 in (^{3}He,p), π=N in (pol d,α).
4561.95 *3*	2⁻		DEFGHI K O	J^π: L=3 in (α,d); L=1+3 in (d,p); proposed 2⁻ in 2014Fi01 (n,γ) based on primary γ feeding. π=N in (pol d,α) indicates 3⁻, evaluators do not consider it as an unpublished work.
4621.14 *20*	(2⁻,1⁺)		D F I K NO	J^π: L=1+3 in (d,p) and L=0 in (^{3}He,p) are conflicting; γ to 1⁺ and 2⁺ and 3⁺; π=N in (pol d,α) (unpublished data). (2)⁺ in (n,γ) E=th and no argument is provided.
4692.06 *22*	(3⁻)		D FGHI K NO	J^π: L=1+3 in (d,p) and in (n,γ) E=th from the 1⁺,2⁺ capture state. L=4 in (^{3}He,p) is conflicting.
4751.027 *17*	(2⁻)		F I K N	J^π: L=1+3 in (d,p), γ to 3⁺ and 1⁺ levels.
4772 *7*			O	J^π: π(pol d,α)=U.
4891.35 *8*	(4)⁻		F K NO	J^π: L=5 in (pol d,P); γ to 4⁺; π(pol d,α)=U (appears to be from private communications).
4908.6 *4*	(3)⁺		FG K N	J^π: L=4 in (pol d,p); γ to 3⁺ and 4⁺ and 5⁺; weaker population by primary γ from 1⁺,2⁺ in (n,γ) thermal.
4939.60 *8*	(1)⁻		F HI K NO	J^π: L=1+3 in (d,p),(d,pγ), π=N in (pol d,α), γ to 1⁺ and 3⁺. 1984Ti01 (n,γ) proposed 1⁻ based on the primary γ feeding from 1⁺,2⁺ capture state. L=2 in (d,^{3}He) (1971Kr04 − from a comparison

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Adopted Levels, Gammas (continued)

^{24}Na Levels (continued)

E(level)[†]	J$^{\pi}$[@]	XREF	Comments
			with typical angular distributions from the ^{24}Mg(d,^{3}He)^{23}Na reaction) – may be considered with caution.
4973.83[‡] *12*		HI K NO	E(level): Others: 4970 *20* in (d,p), 4973 *5* in (d,^{3}He), 4980 *7* in (d,$\alpha\gamma$), and 4980.8 in (n,γ) E=53 keV.
5030.62 *15*	(2,3,4)$^{+}$	F i K N	J$^{\pi}$: L=4 in (pol d,p), γ to 2^{+}.
5045.031 *21*	(2)$^{-}$	EF i K	XREF: E(5040). J$^{\pi}$: L=1+3 in (d,p), γ to 1^{+}, 3^{+}. L=6 in (α,d) probably erroneous.
5059.629 *22*	(3)$^{-}$	FGHI KL N	J$^{\pi}$: L=1+3 in (d,p), γ to 4^{+}.
5117.40 *9*	(2^{-})	FG I K NO	J$^{\pi}$: 1+3 in (d,p), γ to 3^{+} and 1^{+}, stronger primary γ from 1^{+},2^{+} capture state (2014Fi01 – (n,γ)). Negative parity is in conflict with in L=0 from measured dσ/dΩ (12° to 50°) in (pol d,p) (2004To03 – not shown in Fig.) and π(pol d,α)=N – was not considered – unpublished work.
5160 *8*		G i O	
5180.55 *13*		K	
5192.34 *11*	(3^{-})	F K NO	J$^{\pi}$: π=N in (pol d,α), γ to 2^{+} and 4^{+}. L=1+3 in (d,p) at 5180 *20* overlaps three levels.
5252.16 *13*	1^{-}	EF I K NO	XREF: E(5220). J$^{\pi}$: L=1+3 in (pol d,p), π=N in (pol d,α), γ to 0^{+}.
5308.95 *13*	(2^{+})	F K	J$^{\pi}$: 2^{+} from weaker population from 1^{+},2^{+} capture state (n,γ) 2014Fi01. ≠1^{-} or 3^{-} (pol d,p) from γ to (3)$^{+}$ and 1^{+}. Positive parity in conflict with L=1+3 in (pol d,p).
5339.10 *5*	2^{-}	F I K NO	J$^{\pi}$: L=1+3 in (d,p), π=U in (pol d,α).
5397.33 *16*	(3^{-})	F i K nO	XREF: K(?). J$^{\pi}$: L=1+3 in (d,p) for doublet, γ to 4^{+}.
5408.29[‡] *24*	1^{+},2^{+}	i K n	J$^{\pi}$: from L=0 in (pol d,p).
5432 *8*		O	
5454.56 *13*	1^{-},2^{-}	F K N	J$^{\pi}$: L=1 in (d,^{3}He), γ to 1^{+} and 2^{+} levels and stronger population from 1^{+},2^{+} capture state (n,γ) (2014Fi01).
5477 *2*	(1,2,3)$^{+}$	D k	J$^{\pi}$: L=2 in (^{3}He,p).
5478.99 *6*	(1,2)$^{-}$	F I k N	J$^{\pi}$: L=1+3 in (d,p), γ to 1^{+} level.
5571.66[#] *9*	2^{+},3^{+},4^{+}	F i K	J$^{\pi}$: From L(pol d,p)=2+4.
5585 *8*		i O	
5629.3[‡] *7*	1^{-},2^{-},3^{-}	I K N	J$^{\pi}$: From L(pol d,p)=1+3.
5674.46[‡] *27*	1^{+},2^{+}	I K N	J$^{\pi}$: From L(pol d,p)=0.
5737.15[‡] *16*	1^{-},2^{-},3^{-}	I K N	J$^{\pi}$: From L(pol d,p)=1+3.
5775.7 *3*	(2^{+},3^{+})	D F i K N	J$^{\pi}$: (2^{+}) or (3^{+}) based on weaker population by primary γ from 1+2^{+} capture state in (n,γ) thermal. L=1+3 in (pol d,p) yields negative parity, however, the L value based on measured dσ/dΩ (12° to 50°) (2004To03 – not shown in Fig.) and evaluators consider with cautions.
5789.4? *9*		i K	
5809.48 *3*	2^{-}	F i K	J$^{\pi}$: L=1+3 in (pol d,p), γ to 1^{+} and 3^{+} levels and stronger population from 1^{+},2^{+} capture state (n,γ) (2014Fi01).
5850.65[‡] *16*	1^{-},2^{-},3^{-}	F i K N	J$^{\pi}$: From L(pol d,p)=1+3.
5863.13 *20*	(2)	F N	J$^{\pi}$: L=1 in (d,^{3}He), γ to 3^{-}. (2^{+}) based on weaker population from 1^{+},2^{+} capture state (n,γ) (2014Fi01).
5896.69[‡] *9*		I K	
5918.26 *5*	(2)	eF K	J$^{\pi}$: 2^{+},(1^{+}) in 2004To03 (n,γ) and (2^{-}) in 2014Fi01 (n,γ), based on the stronger primary γ feeding from 1^{+},2^{+} capture state. L=5 in (α,d) is not consistent with (1^{-}).
5953.33 *14*	(1^{-})	eF	J$^{\pi}$: From stronger population by primary γ feeding (n,γ) and γ to 0^{+} level. L=5 (α,d) is not consistent with (1^{-}).
5966.24 *17*	(0^{+})	D F	T=2 J$^{\pi}$: L=0 in (^{3}He,p) (see note in the dataset).
6072.75 *5*	(2)	F I K	J$^{\pi}$: 2^{+},(3^{+}) in 2004To03 (n,γ) and (2^{-}) in 2014Fi01 (n,γ), based on the stronger

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Adopted Levels, Gammas (continued)

^{24}Na Levels (continued)

E(level)†	Jπ@	XREF	Comments
			primary γ feeding from 1+,2+ capture state.
6088.2? *5*		K	
6111.56 *18*	(2+,3+)	F	Jπ: γ to 1+ and 4+.
6176.65 *16*	(1−,2−)	F I K	XREF: K(?). Jπ: L=1+3 in (pol d,p), γ to 1+.
6183.1? *7*		K	XREF: K(?).
6199.11? *24*		K	XREF: K(?).
6222.34 *4*	(1+,2+)	F I K N	XREF: K(?). Jπ: Based on primary γ feeding from 1+,2+ capture state (n,γ) (2014Fi01).
6247.49 *5*	(2+,3+)	F L N	Jπ: γ′s to 1+ and 4+ and 2−.
6251.10 *12*	(2)−	eF K	XREF: K(6247.67). E(level): In (pol d,p) (2004To03), reported excited level energy from (n,γ). L=1+3 in (pol d,p) FWHM=5 keV to 8 keV possibly related with this level. Jπ: Based on primary γ feeding from 1+,2+ capture state (n,γ) (2014Fi01). L=1+3 in (pol d,p).
6256.90 *22*	1−	eF I K	Jπ: L=1+3 in (pol d,p), γ to 0+ and 1+. L=(4,5) in (α,d) is not consistent with 1−.
6305.9 *5*	2+,3+,4+	K	Jπ: L(pol d,p)=2+4.
6407.03 *11*	(2−)	F	Jπ: Based on primary γ feeding from 1+,2+ capture state (n,γ) (2014Fi01).
6448.31 *18*		F	
6490 *20*		I	
6550 *20*		I	
6580 *20*		I	
6640		E	
6715 *5*	(1+)	I L N	XREF: I(6690). Jπ: on the basis of the angular distribution data from (d,^{2}He) and the DWBA calculation (2002Ra12).
6787 *5*		I N	XREF: I(6810).
6846 *5*		N	
6905 *5*	−	E I N	XREF: I(6880). E(level),Jπ: From (d,^{3}He) and L(d,^{3}He))=1, respectively.
7084 *5*	−	N	Jπ: L(d,^{3}He))=1.
7144 *5*		N	
7200	(1+)	E L	Jπ: on the basis of the angular distribution data from (d,^{2}He) and the DWBA calculation (2002Ra12).
7246 *5*		N	
7313 *5*		N	
7510	(2,3,4)−	E	Jπ: L(α,d)=3.
7890	(3+,4+,5+)	E	Jπ: L(α,d)=(4).
8080		E	
8390	1+	E	Jπ: L(α,d)=0.
8610		E	
8860	(4−,5−,6−)	E	Jπ: L(α,d)=(5).
9280	(4−,5−,6−)	E	Jπ: L(α,d)=(5).
9630	(5+,6+,7+)	E	Jπ: L(α,d)=(6).
10790	(7+)	E	Jπ: L=6 in (α,d).
11190		E	
11610		E	
11900		E	
12190		E	
12540	(4−,5−,6−)	E	Jπ: L(α,d)=(5).

† From a least-squares fit to Eγ, except where otherwise noted. Assumed ΔE=1 keV, when not available. Uncertainties were doubled for 2565.2γ, 1143.09γ, and 3866.2γ from 2562.99, 3655.8, and 3865.7 keV levels, respectively, and tripled for 2016.3γ

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Adopted Levels, Gammas (continued)

^{24}Na Levels (continued)

from 5953.3 keV level. χ^2=1.98 vs. χ^2_{crit}=1.2 was obtained. Without the increase of uncertainty, χ^2 was 2.4, and all these γ differed by more than 4 standard deviation compared to the fitted values.

‡ From (pol d,p).

From (n,γ) E=Thermal.

@ Natural (N) or unnatural parity (U) from (pol d,α) are listed in J^π arguments should be considered with caution, not published – appears to be from private communiacations.

& From (d,pγ), except where otherwise noted. Doppler Shift Attenuation (DSA) method.

[a] Many ^{24}Na g.s. half-life values are available in the literature as listed in the comments section. The central value of these data mainly clusters into two groups, one at about 14.9 h and another one at about 15.0 h. Some studies reported results with higher precision without detailed documentation. Since 1980, several targeted ^{24}Na g.s. half-life measurements were carried out for better accuracy and precision, as reported in 1980Mu11, 1983Wa26, and measurements at NIST (2014Un01 and others). These latter studies support only one cluster of the data and conclude that some measurements might affected by impurity or other contributions.

[b] From (^{3}He,pγ) – Doppler Shift Attenuation (DSA) method.

$\gamma(^{24}Na)$

E_i(level)	J^π_i	E_γ†	I_γ†	E_f	J^π_f	Mult.‡	δ‡	α&	Comments
472.2071	1^+	472.2023 *14*	100	0.0	4^+	[M3]		4.69×10^{-4}	B(M3)(W.u.)=5.3 *36* α(K)=0.000442 *7*; α(L)=2.67×10^{-5} *4*; α(M)=5.95×10^{-7} *9*
563.1993	2^+	90.9922 *14*	100.0 *5*	472.2071	1^+				I_γ: weighted average of 100.0 *11* from (n,γ) E=thermal and 100.0 *5* from (d,pγ).
		563.188 *13*	3.74 *2*	0.0	4^+	[E2]			B(E2)(W.u.)=2.50 *+42−32*
1341.438	2^+	778.23 *4*	5.47 *6*	563.1993	2^+				
		869.225 *23*	100.0 *8*	472.2071	1^+				
		1340.98 *22*	0.087 *14*	0.0	4^+	[E2]			B(E2)(W.u.)=0.52 *+20−14*
1344.648	$3^{(+)}$	781.444 *48*	80.5 *8*	563.1993	2^+	(M1+E2)			Mult.: D+Q from γ(θ), (M1+E2) is listed based on level scheme for transition strength calculation. δ: +0.08 *3* or −6.3 *+12−33* (1971Bu21) for 3 to 2^+ transition – ^{26}Mg(d,αγ),(pol d,α).
		1344.604 *10*	100 *1*	0.0	4^+	(M1+E2)			Mult.: D+Q from γ(θ), (M1+E2) is listed based on level scheme for transition strength calculation. δ: +0.00 *4* or −7.1 *+15−25* (1971Bu21) for 3 to 4^+ transition – ^{26}Mg(d,αγ),(pol d,α).
1346.635	1^+	783.40 *22*	0.73 *5*	563.1993	2^+				
		874.420 *30*	100.0 *8*	472.2071	1^+				
1513.7	5^+	1514.7 *4*	100	0.0	4^+	M1+E2	−0.16 *4*	7.29×10^{-5} *11*	α=7.29×10^{-5} *11*; α(K)=4.77×10^{-6} *7*; α(L)=2.86×10^{-7} *4*; α(M)=6.40×10^{-9} *10* α(IPF)=6.79×10^{-5} *11* B(M1)(W.u.)=0.23 *+7−4*; B(E2)(W.u.)=16 *+11−7*
1846.026	2^+	499.384 *7*	100.0 *15*	1346.635	1^+				
		501.45 *9*	21.3 *7*	1344.648	$3^{(+)}$				I_γ: Other: 28 *5* (d,pγ).
		504.59 *4*	10.2 *4*	1341.438	2^+				
		1282.812 *13*	37.5 *3*	563.1993	2^+				I_γ: Others: 39.5 *23* (d,pγ) and 24 *6* (d,αγ). Weighted average of all gives the same value with higher uncertainty. In (n,γ) E=10-30 keV only two depopulating gammas and yield 100 *35*.
		1373.56 *11*	56.0 *7*	472.2071	1^+	M1+E2	+0.18 *7*	3.94×10^{-5} *8*	α=3.94×10^{-5} *8*; α(K)=5.66×10^{-6} *9*; α(L)=3.39×10^{-7} *6*; α(M)=7.59×10^{-9} *12* α(IPF)=3.34×10^{-5} *7* B(M1)(W.u.)=0.0120 *+30−21*; B(E2)(W.u.)=1.3 *+12−8* I_γ: Others: 65.1 *23* (d,pγ), 73 *6* (d,αγ), and 26 *13* if Ig(1282.8)=37.5 instead of 100 in (n,γ) E=10-30 keV. The unweighted yields 55 *10*. Discrepant data set.
1885.537	3^+	1322.329 *14*	100.0 *8*	563.1993	2^+	(M1+E2)		2.99×10^{-5} *5*	α=2.99×10^{-5} *5*; α(K)=5.99×10^{-6} *9*; α(L)=3.59×10^{-7} *5*; α(M)=8.04×10^{-9} *12* α(IPF)=2.35×10^{-5} *4* δ: +0.02 *2* or −4.7 *4* (1971Bu21) for 3^+ to 2^+ transition – ^{26}Mg(d,αγ),(pol d,α).

$^{24}_{11}Na_{13}$-7

Adopted Levels, Gammas (continued)

$\gamma(^{24}Na)$ (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.[‡]	δ[‡]	α[&]	Comments
1885.537	3^+	1412.4 *8*	1.2 *3*	472.2071	1^+	[E2]			B(E2)(W.u.)=7.3 *+30−22*
		1885.44 *5*	53 *4*	0.0	4^+	(M1+E2)			I_γ: unweighted average of 56.9 *23* from (n,γ) E=thermal, 56.3 *31* from (d,pγ), and 45 *4* from (d,$\alpha\gamma$). δ: −0.07 *2* or −5.4 *4* (1971Bu21) for 3^+ to 4^+ transition – ^{26}Mg(d,$\alpha\gamma$),(pol d,α).
2513.37	3^+	1172.1 *4*	1.65 *24*	1341.438	2^+				
		1950.22 *12*	100.0 *10*	563.1993	2^+				I_γ: weighted average of 100.0 *14* from (n,γ) E=thermal and 100.0 *11* from (d,pγ).
		2513.5 *4*	4.6 *12*	0.0	4^+				I_γ: weighted average of 8.4 *34* from (n,γ) E=thermal and 4.2 *11* from (d,pγ).
2563.06	4^+	1050.4 *5*	28 *4*	1513.7	5^+				I_γ: weighted average of 29 *4* from (d,pγ) and 23 *9* if Iγ(1218)=100 from (d,$\alpha\gamma$). Other: 23 *8* in (n,γ) E=thermal from literature (ealier evaluation), not considered.
		1217.66 *24*	100 *4*	1344.648	$3^{(+)}$				I_γ: weighted average of 100 *15* from (n,γ) E=thermal, and 100 *4* from (d,pγ). Other: 91 *17* in (d,$\alpha\gamma$).
		2565.2 *5*	63 *4*	0.0	4^+				I_γ: From (d,pγ). Others: 110 *17* if Iγ(1218)=100 (d,$\alpha\gamma$), 5.8 *23* in (n,γ) E=thermal.
2903.935	3^+	390.51 *15*	1.6 *2*	2513.37	3^+				
		1018.3 *5*	2.7 *4*	1885.537	3^+				
		1057.9 *3*	6.3 *17*	1846.026	2^+				I_γ: weighted average of 9 *4* from (n,γ) E=thermal and 5.7 *19* from (d,pγ). Other: 5.5 *36* if Iγ(1564)=100 (actually <100) in (d,$\alpha\gamma$).
		1559.28 *7*	55.1 *10*	1344.648	$3^{(+)}$				
		1562.462 *29*	100 *10*	1341.438	2^+				
		2341.1 *6*	4.6 *12*	563.1993	2^+				I_γ: weighted average of 5.1 *16* from (n,γ) E=thermal and 3.8 *19* from (d,pγ). Other: 9.1 *55* if Iγ(1564)=100 (actually <100) in (d,$\alpha\gamma$).
		2431.9 *4*	20.0 *14*	472.2071	1^+	[E2]			B(E2)(W.u.)=4.3 *+14−9*
		2903.70 *4*	23.5 *21*	0.0	4^+	(M1(+E2))	<+0.14	6.21×10^{-4}	α(K)=1.703×10^{-6} *24*; α(L)=1.020×10^{-7} *15*; α(M)=2.29×10^{-9} *4* α(IPF)=0.000619 *9* B(M1)(W.u.)=0.0028 *+15−9* I_γ: Weighted average of 23.7 *24* from (n,γ) E=thermal and 23 *4* from (d,pγ). Other: 27 *9* if Iγ(1564)=100 (actually <100) (d,$\alpha\gamma$).
2977.776	2^+	1092.21 *3*	6.41 *8*	1885.537	3^+				
		1131.31 *12*	0.60 *8*	1846.026	2^+				
		1631.04 *15*	3.28 *23*	1346.635	1^+				
		1633.41 *16*	23.8 *3*	1344.648	$3^{(+)}$				
		1636.34 *6*	97.5 *10*	1341.438	2^+				
		2414.43 *4*	100.0 *14*	563.1993	2^+				
		2505.49 *6*	66.4 *6*	472.2071	1^+				
		2977.28 *23*	2.2 *1*	0.0	4^+				
3216.08	$(4)^+$	1330.52 *19*		1885.537	3^+				E_γ: Placement in 2014Fi01 (n,γ) based on the energy sum and

Adopted Levels, Gammas (continued)

$\gamma(^{24}Na)$ (continued)

E_i(level)	J^π_i	E_γ†	I_γ†	E_f	J^π_f	Mult.‡	Comments
							consistency with the level scheme, however, did not place the other 1872γ (d,p),(d,pγ) or 1875γ (d,$\alpha\gamma$),(pol d,α) from this level. A comparable 1875.6γ placed from 6072.76 keV level.
3216.08	(4)$^+$	1874		1341.438	2$^+$		E_γ: Average of 1872 (d,p),(d,pγ) and 1876 (d,$\alpha\gamma$),(pol d,α).
3371.830	2$^-$	857.0 *4*	0.25 *10*	2513.37	3$^+$	[E1]	B(E1)(W.u.)=1.1×10^{-4} *+6−5*
		1486.20 *6*	3.72 *5*	1885.537	3$^+$	[E1]	B(E1)(W.u.)=3.1×10^{-4} *+9−6*
		1526.1 *6*	0.27 *8*	1846.026	2$^+$	[E1]	B(E1)(W.u.)=2.1×10^{-5} *+9−7*
		2025.13 *5*	100.0 *8*	1346.635	1$^+$	[E1]	B(E1)(W.u.)=0.0033 *+10−6*
		2027.18 *11*	12.2 *3*	1344.648	3$^{(+)}$	[E1]	B(E1)(W.u.)=0.00040 *+11−8*
		2030.26 *7*	64.9 *8*	1341.438	2$^+$	[E1]	B(E1)(W.u.)=0.0021 *+6−4*
		2808.45 *6*	48.8 *6*	563.1993	2$^+$	[E1]	B(E1)(W.u.)=0.00060 *+17−11* I_γ: weighted average of 48.8 *6* from (n,γ) E=thermal and 45 *7* from (d,pγ).
		2898.9 *6*	0.57 *11*	472.2071	1$^+$	[E1]	B(E1)(W.u.)=6.3×10^{-6} *+23−17*
3413.278	1$^+$	1567.18 *8*	8.8 *3*	1846.026	2$^+$		
		2066.55 *10*	21.3 *4*	1346.635	1$^+$		
		2071.69 *10*	100 *4*	1341.438	2$^+$		
		2850.04 *11*	24.7 *14*	563.1993	2$^+$		I_γ: weighted average of 24.4 *13* from (n,γ) E=thermal and 32 *7* from (d,pγ).
		2940.85 *9*	56.2 *6*	472.2071	1$^+$		I_γ: weighted average of 56.0 *6* from (n,γ) E=thermal and 90 *7* from (d,pγ).
3589.31	1$^+$	685.54 *12*	2.4 *2*	2903.935	3$^+$		
		1743.25 *16*	4.6 *2*	1846.026	2$^+$		
		2242.44 *20*	8.2 *11*	1346.635	1$^+$		
		2247.84 *15*	6.0 *5*	1341.438	2$^+$		
		3025.69 *8*	100 *4*	563.1993	2$^+$		I_γ: Other: 80 *4* (d,pγ).
		3116.86 *6*	53 *2*	472.2071	1$^+$		I_γ: Other: 100 *4* (d,pγ).
3628.18	3$^+$	2283.0 *4*	55 *6*	1344.648	3$^{(+)}$		
		2286.58 *8*	100 *4*	1341.438	2$^+$		
		3628.11 *17*	94 *3*	0.0	4$^+$		I_γ: weighted average of 89.9 *32* from (n,γ) E=thermal and 100 *4* from (d,pγ).
3655.84	(2$^+$,1$^+$,3$^+$)	242.30 *9*	14.3 *14*	3413.278	1$^+$		
		1143.09 *14*	34 *4*	2513.37	3$^+$		
		1770.25 *16*	33 *11*	1885.537	3$^+$		I_γ: unweighted average of 44.3 *14* from (n,γ) E=thermal and 22 *7* from (d,pγ).
		1809.8 *4*	19 *7*	1846.026	2$^+$		I_γ: unweighted average of 25.7 *22* from (n,γ) E=thermal and 12.1 *35* from (d,pγ).
		2310.2 *4*	12 *4*	1344.648	3$^{(+)}$		I_γ: From (d,pγ). Other: 24 *5* (n,γ) E=Thermal for multiple placement and undivided intensity.
		2314.3 *3*	17 *5*	1341.438	2$^+$		I_γ: unweighted average of 21.4 *9* from (n,γ) E=thermal and 12.1 *35* from (d,pγ).
		3093.08 *31*	100 *5*	563.1993	2$^+$		I_γ: From (d,pγ).
		3184.1 *6*	37 *5*	472.2071	1$^+$		I_γ: unweighted average of 39 *4* from (n,γ) E=thermal and 26 *10* from (d,pγ).
3681.78	0$^+$	2334.9 *6*	3.4 *4*	1346.635	1$^+$		
		3209.32 *5*	100.0 *11*	472.2071	1$^+$		
3745.04	3$^-$	373.11 *15*	1.75 *13*	3371.830	2$^-$		
		1231.5 *4*	9 *5*	2513.37	3$^+$		I_γ: unweighted average of 4.5 *5* from (n,γ) E=thermal and 14.3 *24* from (d,pγ).
		1859.4 *3*	13 *4*	1885.537	3$^+$		I_γ: unweighted average of 8.4 *8* from (n,γ) E=thermal and 16.7 *24* from (d,pγ).
		1899.10 *10*	100 *5*	1846.026	2$^+$		I_γ: From (d,pγ).
		2400.29 *18*	30.0 *10*	1344.648	3$^{(+)}$		I_γ: Other: 50 *10* (d,pγ).

Adopted Levels, Gammas (continued)

$\gamma(^{24}Na)$ (continued)

E_i(level)	J^π_i	E_γ†	I_γ†	E_f	J^π_f	Comments
3745.04	3^-	2403.63 *10*	35.4 *8*	1341.438	2^+	I_γ: weighted average of 35.5 *8* from (n,γ) E=thermal and 26 *10* from (d,pγ).
		3181.61 *43*	30.7 *9*	563.1993	2^+	I_γ: weighted average of 30.8 *9* from (n,γ) E=thermal and 26 *5* from (d,pγ).
		3744.30 *15*	4.38 *25*	0.0	4^+	I_γ: weighted average of 4.38 *25* from (n,γ) E=thermal and 4.8 *12* from (d,pγ).
3865.69		2019.60 *14*	100 *24*	1846.026	2^+	
		2523.88 *14*	59 *4*	1341.438	2^+	
		3866.20 *14*	35.3 *18*	0.0	4^+	
3933.58	$(1^+,2^+,3)$	1420.00 *18*	6.2 *8*	2513.37	3^+	
		2087.48 *14*	36.9 *9*	1846.026	2^+	
		2588.72 *13*	73 *4*	1344.648	$3^{(+)}$	
		2592.10 *12*	100 *6*	1341.438	2^+	I_γ: Other: 64 *10* (d,pγ).
		3370.12 *8*	42 *21*	563.1993	2^+	I_γ: Other: 100 *10* (d,pγ).
3943.66	(2^+)	3471.27 *7*	100 *4*	472.2071	1^+	
		3942.80 *17*	32.1 *16*	0.0	4^+	
3977.33	1^-	387.98 *18*	0.38 *8*	3589.31	1^+	
		605.46 *18*	2.33 *23*	3371.830	2^-	
		999.7 *3*	1.28 *23*	2977.776	2^+	
		2131.35 *5*	2.9 *3*	1846.026	2^+	
		2630.56 *6*	41.7 *5*	1346.635	1^+	
		2635.36 *12*	2.93 *23*	1341.438	2^+	
		3413.78 *6*	62.4 *11*	563.1993	2^+	I_γ: weighted average of 62.3 *8* from (n,γ) E=thermal and 72 *7* from (d,pγ).
		3504.82 *10*	100.0 *8*	472.2071	1^+	
4048.83	$(0,1,2)^-$	2701.4 *4*	62 *8*	1346.635	1^+	
		3576.5 *3*	100 *22*	472.2071	1^+	
4143.21	(4^+)	1578.0 *6*	22 *4*	2563.06	4^+	
		2297.04 *17*	100 *9*	1846.026	2^+	
		4144.5 *5*	22 *4*	0.0	4^+	
4185.7	$(1,3)^+$	2301.3 *6*	100# *5*	1885.537	3^+	
		2842	56# *5*	1344.648	$3^{(+)}$	
4196.18	$(2)^-$	1218.2 *5*	7.9 *13*	2977.776	2^+	
		1292.4 *3*	2.3 *7*	2903.935	3^+	
		1683.1 *3*	6.3 *10*	2513.37	3^+	
		2310.2 *4*	<13.5	1885.537	3^+	I_γ: From 11.2 *23* in a multiplet.
		2349.9 *3*	17.5 *13*	1846.026	2^+	
		3632.64 *13*	34 *3*	563.1993	2^+	
		3723.59 *10*	100 *2*	472.2071	1^+	
4207.143	$(2)^-$	551.2 *3*	1.88 *6*	3655.84	$(2^+,1^+,3^+)$	
		617.84 *5*	0.79 *6*	3589.31	1^+	
		793.85 *4*	11.52 *12*	3413.278	1^+	
		835.31 *3*	63.0 *6*	3371.830	2^-	
		1229.35 *4*	8.48 *18*	2977.776	2^+	
		1693.83 *14*	3.6 *5*	2513.37	3^+	
		2361.04 *6*	48.1 *12*	1846.026	2^+	
		2860.29 *3*	100.0 *12*	1346.635	1^+	

γ(^{24}Na) (continued)

E_i(level)	J^{π}_i	E_{γ}†	I_{γ}†	E_f	J^{π}_f	Comments
4207.143	(2)$^-$	2865.61 *6*	65 *3*	1341.438	2$^+$	
		3643.56 *4*	39.1 *1*	563.1993	2$^+$	
		3734.58 *12*	2.4 *3*	472.2071	1$^+$	
4220.6		2707	100# *7*	1513.7	5$^+$	
		4220	11# *7*	0.0	4$^+$	
4441.641	2$^-$	464.47 *12*	0.77 *14*	3977.33	1$^-$	
		696.69 *19*	0.93 *7*	3745.04	3$^-$	
		785.8 *3*	0.89 *14*	3655.84	(2$^+$,1$^+$,3$^+$)	
		813.0 *5*	0.35 *5*	3628.18	3$^+$	
		852.33 *7*	2.1 *3*	3589.31	1$^+$	
		1028.33 *11*	1.54 *5*	3413.278	1$^+$	
		1928.23 *4*	21.1 *4*	2513.37	3$^+$	
		2556.14 *10*	1.82 *16*	1885.537	3$^+$	
		2595.49 *5*	22.5 *3*	1846.026	2$^+$	
		3094.80 *3*	12.6 *14*	1346.635	1$^+$	
		3096.62 *6*	84.6 *12*	1344.648	3$^{(+)}$	
		3099.90 *6*	65.0 *12*	1341.438	2$^+$	
		3878.08 *4*	100.0 *12*	563.1993	2$^+$	
		3969.08 *11*	10.0 *2*	472.2071	1$^+$	
4561.95	2$^-$	906.20 *20*	12 *3*	3655.84	(2$^+$,1$^+$,3$^+$)	
		1584.17 *16*	8.5 *4*	2977.776	2$^+$	
		2048.27 *24*	17.5 *7*	2513.37	3$^+$	
		2715.82 *6*	100.0 *12*	1846.026	2$^+$	
		4089.37 *9*	71 *3*	472.2071	1$^+$	
4621.14	(2$^-$,1$^+$)	992.6 *5*	3.3 *33*	3628.18	3$^+$	
		1208.3 *3*	63 *28*	3413.278	1$^+$	
		2106.5 *5*	<49	2513.37	3$^+$	I_{γ}: From 37 *12* in a multiplet.
		4057.7 *4*	100 *12*	563.1993	2$^+$	
4692.06	(3$^-$)	1035.3 *4*	57 *29*	3655.84	(2$^+$,1$^+$,3$^+$)	
		1714.2 *3*	100 *33*	2977.776	2$^+$	
		2806.3 *12*	35 *14*	1885.537	3$^+$	E_{γ},I_{γ}: From (n,γ) E=10-80 keV. Intensity from scaling Iγ(4693) to 67.
		4693.2 *8*	67 *10*	0.0	4$^+$	
4751.027	(2$^-$)	543.94 *13*	0.54 *7*	4207.143	(2)$^-$	
		702.13 *16*	3.5 *3*	4048.83	(0,1,2)$^-$	
		773.86 *14*	6.5 *7*	3977.33	1$^-$	
		1005.969 *41*	12.6 *4*	3745.04	3$^-$	
		1095.05 *7*	8.8 *1*	3655.84	(2$^+$,1$^+$,3$^+$)	
		1337.80 *4*	42 *2*	3413.278	1$^+$	
		1378.80 *12*	4.8 *5*	3371.830	2$^-$	
		1773.15 *6*	12.9 *3*	2977.776	2$^+$	
		1847.06 *17*	5.9 *3*	2903.935	3$^+$	
		2237.46 *12*	13.3 *16*	2513.37	3$^+$	
		2865.41 *3*	36 *5*	1885.537	3$^+$	

Adopted Levels, Gammas (continued)

γ(^{24}Na) (continued)

E_i(level)	J_i^{π}	E_{γ}†	I_{γ}†	E_f	J_f^{π}	Comments
4751.027	(2$^-$)	2904.74 *6*	72.8 *14*	1846.026	2$^+$	
		3409.23 *7*	30.1 *5*	1341.438	2$^+$	
		4187.35 *3*	100.0 *14*	563.1993	2$^+$	
		4278.76 *23*	0.95 *7*	472.2071	1$^+$	
4891.35	(4)$^-$	4890.82 *8*	100	0.0	4$^+$	
4908.6	(3)$^+$	2004.0 *5*	71 *14*	2903.935	3$^+$	E_{γ},I_{γ}: From (n,γ) E=10-80 keV.
		3395.9 *8*	90 *12*	1513.7	5$^+$	E_{γ},I_{γ}: From (n,γ) E=10-80 keV.
		3563.7 *8*	45 *17*	1344.648	3$^{(+)}$	E_{γ},I_{γ}: From (n,γ) E=10-80 keV.
		4908.2 *9*	100 *13*	0.0	4$^+$	E_{γ},I_{γ}: From (n,γ) E=10-80 keV.
4939.60	(1)$^-$	1526.1 *6*	5.9 *17*	3413.278	1$^+$	
		2426.44 *22*	9.4 *14*	2513.37	3$^+$	
		3594.2 *5*	19.4 *24*	1344.648	3$^{(+)}$	
		3597.4 *4*	24.3 *24*	1341.438	2$^+$	
		4376.00 *11*	36.8 *21*	563.1993	2$^+$	
		4466.89 *11*	100.0 *14*	472.2071	1$^+$	
5030.62	(2,3,4)$^+$	4466.97 *15*	100	563.1993	2$^+$	
5045.031	(2)$^-$	1415.8 *10*	2.0 *7*	3628.18	3$^+$	
		1455.4 *4*	8 *5*	3589.31	1$^+$	
		1631.54 *8*	46 *7*	3413.278	1$^+$	
		3198.97 *10*	49.1 *12*	1846.026	2$^+$	
		3698.08 *10*	44.3 *15*	1346.635	1$^+$	
		3703.29 *7*	100.0 *17*	1341.438	2$^+$	
		4481.41 *3*	43.3 *22*	563.1993	2$^+$	
		4572.32 *4*	21.2 *24*	472.2071	1$^+$	
5059.629	(3)$^-$	852.32 *7*	22 *4*	4207.143	(2)$^-$	
		863.37 *20*	13 *6*	4196.18	(2)$^-$	
		1314.57 *13*	14.5 *5*	3745.04	3$^-$	
		1470.0 *3*	2.0 *5*	3589.31	1$^+$	
		1646.16 *20*	6.0 *5*	3413.278	1$^+$	
		2545.9 *5*	8.5 *15*	2513.37	3$^+$	
		3174.00 *13*	13.8 *8*	1885.537	3$^+$	
		3712.79 *14*	10.8 *15*	1346.635	1$^+$	
		4496.00 *3*	100.0 *15*	563.1993	2$^+$	
		4586.95 *4*	36.3 *10*	472.2071	1$^+$	
		5058.7 *7*	5.3 *5*	0.0	4$^+$	
5117.40	(2$^-$)	2139.4 *4*	33 *7*	2977.776	2$^+$	
		3231.6 *6*	27 *3*	1885.537	3$^+$	
		3270.77 *24*	100 *3*	1846.026	2$^+$	
		3770.77 *16*	94 *3*	1346.635	1$^+$	
		3776.7 *4*	16 *2*	1341.438	2$^+$	
		4553.5 *3*	72 *5*	563.1993	2$^+$	
		4644.57 *12*	52 *2*	472.2071	1$^+$	
5192.34	(3$^-$)	4628.56 *12*	100 *5*	563.1993	2$^+$	

$^{24}_{11}Na_{13}$-12

Adopted Levels, Gammas (continued)

γ(^{24}Na) (continued)

E_i(level)	J_i^π	E_γ†	I_γ†	E_f	J_f^π	Comments
5192.34	(3$^-$)	5191.99 *19*	18.6 *23*	0.0	4$^+$	
5252.16	1$^-$	810.4 *3*	100 *44*	4441.641	2$^-$	
		1570.17 *17*	78 *11*	3681.78	0$^+$	
5308.95	(2$^+$)	3964.13 *15*	100 *8*	1344.648	3$^{(+)}$	
		4836.06 *24*	55 *5*	472.2071	1$^+$	
5339.10	2$^-$	3492.93 *12*	26.8 *6*	1846.026	2$^+$	
		3997.61 *9*	100.0 *16*	1341.438	2$^+$	
		4775.23 *6*	53.2 *13*	563.1993	2$^+$	
		4866.27 *20*	5.1 *3*	472.2071	1$^+$	
5397.33	(3$^-$)	1741.48 *24*	20 *4*	3655.84	(2$^+$,1$^+$,3$^+$)	
		4055.49 *20*	100 *19*	1341.438	2$^+$	
		5396.6 *8*	0.35 *18*	0.0	4$^+$	
5454.56	1$^-$,2$^-$	1012.5 *5*	4.0 *10*	4441.641	2$^-$	
		1477.4 *5*	5.3 *7*	3977.33	1$^-$	
		2040.9 *3*	4.6 *13*	3413.278	1$^+$	
		4107.6 *7*	4.3 *13*	1346.635	1$^+$	
		4890.87 *15*	100 *6*	563.1993	2$^+$	
		4982.7 *7*	21 *5*	472.2071	1$^+$	
5478.99	(1,2)$^-$	2106.5 *5*	<20	3371.830	2$^-$	I_γ: From 15 *5* in a multiplet.
		3632.70 *13*	68 *7*	1846.026	2$^+$	
		4131.7 *9*	20.5 *13*	1346.635	1$^+$	
		4137.14 *12*	100.0 *26*	1341.438	2$^+$	
		4915.00 *16*	37.7 *20*	563.1993	2$^+$	
		5006.30 *8*	29.1 *13*	472.2071	1$^+$	
5775.7	(2$^+$,3$^+$)	4433.8 *3*	100	1341.438	2$^+$	
5809.48	2$^-$	1247.504 *23*	100.0 *18*	4561.95	2$^-$	
		1832.00 *11*	73 *3*	3977.33	1$^-$	
		2220.00 *7*	73 *5*	3589.31	1$^+$	
		3295.6 *8*	2.3 *9*	2513.37	3$^+$	
		4462.42 *4*	62.0 *14*	1346.635	1$^+$	
		5245.51 *21*	4.1 *5*	563.1993	2$^+$	
		5336.64 *17*	6.3 *5*	472.2071	1$^+$	
5863.13	(2)	2118.0 *4*	100 *35*	3745.04	3$^-$	
		4521.23 *22*	65 *5*	1341.438	2$^+$	
5918.26	(2)	858.1 *5*	83 *45*	5059.629	(3)$^-$	
		1225.0 *6*	10 *3*	4692.06	(3$^-$)	
		1711.16 *16*	33 *4*	4207.143	(2)$^-$	
		2546.51 *21*	22 *4*	3371.830	2$^-$	
		4571.14 *5*	88 *10*	1346.635	1$^+$	
		5445.49 *16*	100.0 *19*	472.2071	1$^+$	
5953.33	(1$^-$)	2009.60 *17*	100 *12*	3943.66	(2$^+$)	
		2016.4 *4*	44 *14*	3933.58	(1$^+$,2$^+$,3)	
		2271.2 *3*	12 *3*	3681.78	0$^+$	

$^{24}_{11}$Na$_{13}$-13

Adopted Levels, Gammas (continued)

$\gamma(^{24}Na)$ (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Comments
5953.33	(1⁻)	4107.3 *3*	16.2 *22*	1846.026	2⁺	
5966.24	(0⁺)	2378.0 *8*	13.6 *26*	3589.31	1⁺	I_γ: weighted average of 13.2 *26* from (^{3}He,pγ) and 17 *8* from (n,γ) E=thermal.
		4619.10 *18*	18[@] *4*	1346.635	1⁺	I_γ: Other: 17 *8* in (n,γ) E=th.
		5492.8 *7*	100[@] *5*	472.2071	1⁺	I_γ: Other: 100 *17* in (n,γ) E=th.
6072.75	(2)	820.27 *21*	9.6 *27*	5252.16	1⁻	
		1875.6 *4*	8.4 *27*	4196.18	(2)⁻	
		2482.9 *5*	5.7 *12*	3589.31	1⁺	
		3168.3 *3*	13.3 *9*	2903.935	3⁺	
		4187.39 *26*	9 *3*	1885.537	3⁺	
		4226.32 *14*	9.6 *6*	1846.026	2⁺	
		4725.81 *9*	30.7 *15*	1346.635	1⁺	
		4727.58 *7*	7.2 *21*	1344.648	3⁽⁺⁾	
		4730.69 *9*	100.0 *24*	1341.438	2⁺	
		5507.8 *8*	1.5 *9*	563.1993	2⁺	
		5599.94 *14*	38.6 *9*	472.2071	1⁺	
6111.56	(2⁺,3⁺)	2521.92 *21*	100 *9*	3589.31	1⁺	
		6111.1 *3*	11.9 *16*	0.0	4⁺	
6176.65	(1⁻,2⁻)	4829.68 *18*	93 *7*	1346.635	1⁺	
		5703.2 *3*	100 *7*	472.2071	1⁺	
6222.34	(1⁺,2⁺)	3244.31 *7*	5 *2*	2977.776	2⁺	
		4376.02 *13*	100 *5*	1846.026	2⁺	
		4875.18 *7*	6.1 *10*	1346.635	1⁺	
		5658.41 *7*	6.1 *10*	563.1993	2⁺	
6247.49	(2⁺,3⁺)	1685.7 *3*	3.7 *7*	4561.95	2⁻	
		2062.4 *4*	18 *6*	4185.7	(1,3)⁺	
		2270.3 *6*	5.4 *15*	3977.33	1⁻	
		2591.71 *20*	100 *10*	3655.84	(2⁺,1⁺,3⁺)	
		2657.6 *3*	7.1 *7*	3589.31	1⁺	
		2833.7 *3*	3.7 *5*	3413.278	1⁺	
		2875.6 *4*	5.1 *5*	3371.830	2⁻	
		3343.27 *8*	53 *4*	2903.935	3⁺	
		4361.57 *17*	4.88 *24*	1885.537	3⁺	
		4900.46 *13*	34.9 *22*	1346.635	1⁺	
		4902.0 *3*	45 *18*	1344.648	3⁽⁺⁾	
		4904.2 *5*	22 *5*	1341.438	2⁺	
		5683.2 *3*	3.2 *5*	563.1993	2⁺	
		5774.62 *13*	60.7 *12*	472.2071	1⁺	
		6246.5 *12*	0.73 *24*	0.0	4⁺	
6251.10	(2)⁻	943.4 *5*	17 *4*	5308.95	(2⁺)	
		2623.3 *4*	28 *7*	3628.18	3⁺	
		2661.55 *14*	72 *6*	3589.31	1⁺	
		4404.4 *3*	100 *7*	1846.026	2⁺	
		4908.6 *6*	67 *19*	1341.438	2⁺	

$^{24}_{11}Na_{13}$-14

Adopted Levels, Gammas (continued)

$\gamma(^{24}Na)$ (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f
6256.90	1^-	2279.3 *4*	100 *21*	3977.33	1^-
		2574.9 *3*	42 *10*	3681.78	0^+
		5784.4 *5*	48 *4*	472.2071	1^+
6407.03	(2^-)	1964.3 *4*	13 *5*	4441.641	2^-
6407.03	(2^-)	2993.62 *11*	100 *5*	3413.278	1^+
		6406.4 *7*	20 *5*	0.0	4^+
6448.31		3934.34 *25*	78 *9*	2513.37	3^+
		4562.57 *25*	100 *9*	1885.537	3^+

† From (n,γ) E=Thermal, except where otherwise noted.

‡ From (d,$\alpha\gamma$), based on α-γ angular correlation measurements, except where otherwise noted. Magnetic and electric nature assigned based on RUL, if applicable.

From (d,pγ).

@ From (^{3}He,pγ).

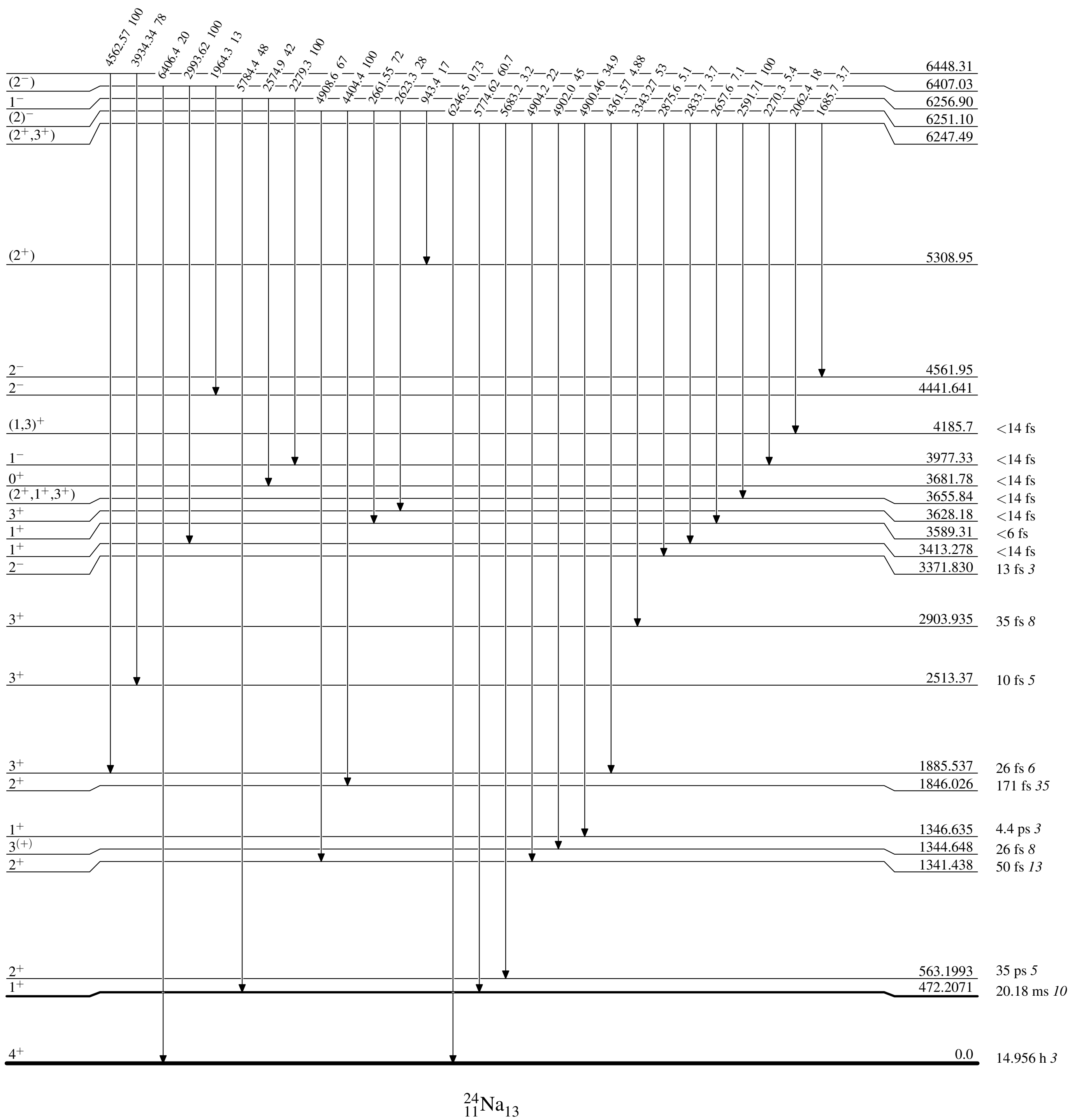
& Additional information 1.

$^{24}_{11}Na_{13}$-15

Adopted Levels, Gammas

Level Scheme

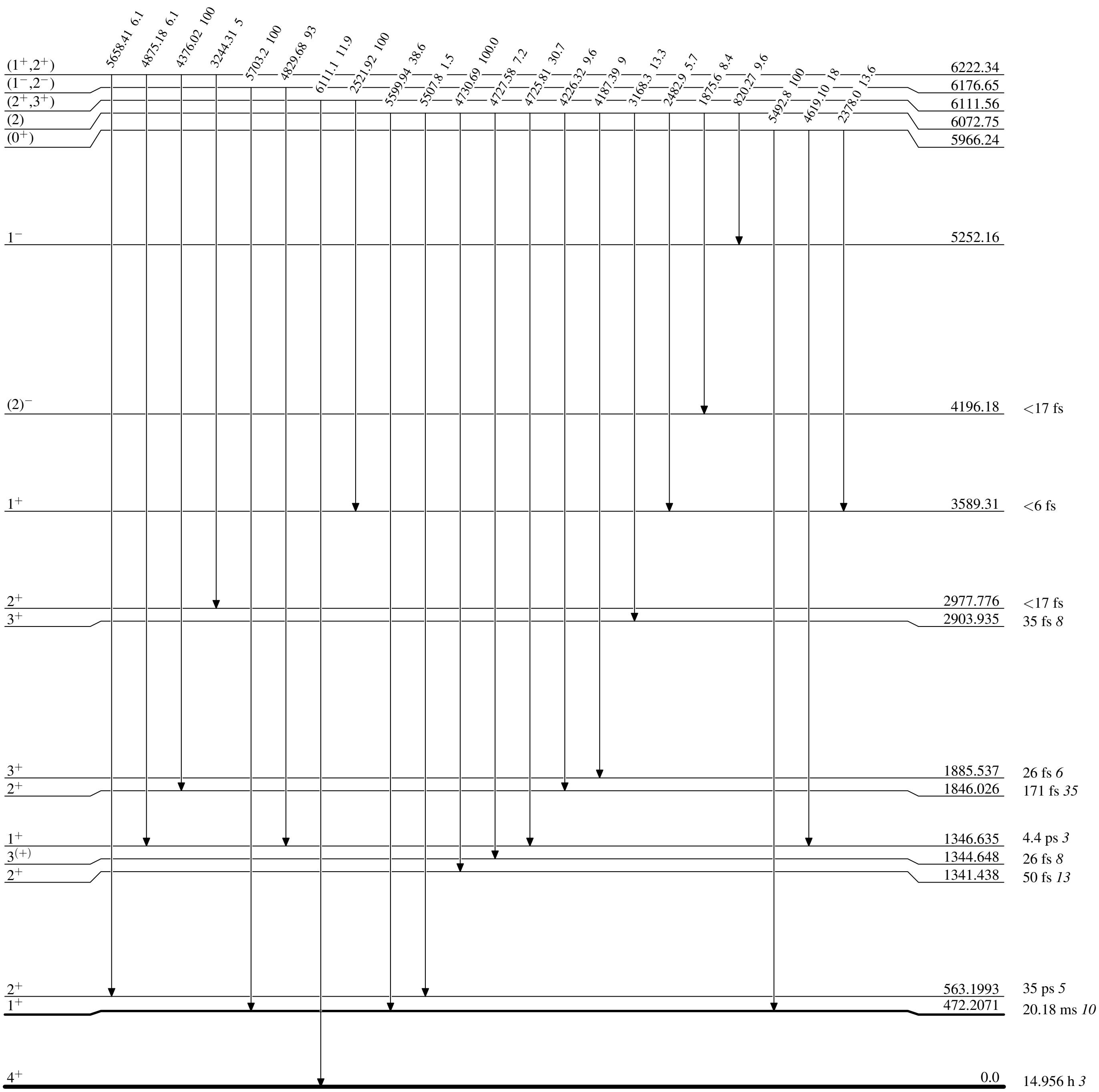
Intensities: Relative photon branching from each level



Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level

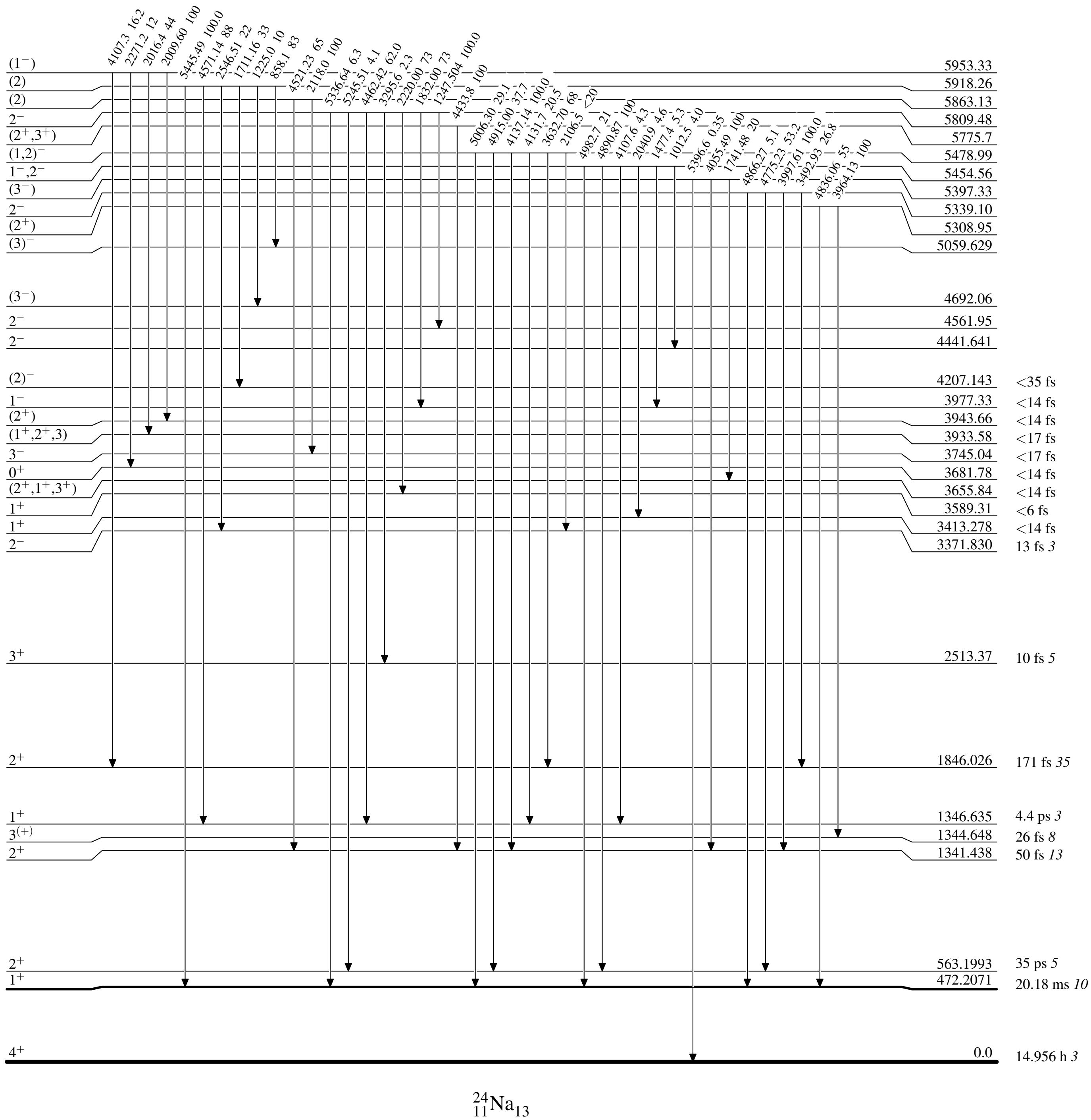


$^{24}_{11}Na_{13}$

Adopted Levels, Gammas

Level Scheme (continued)

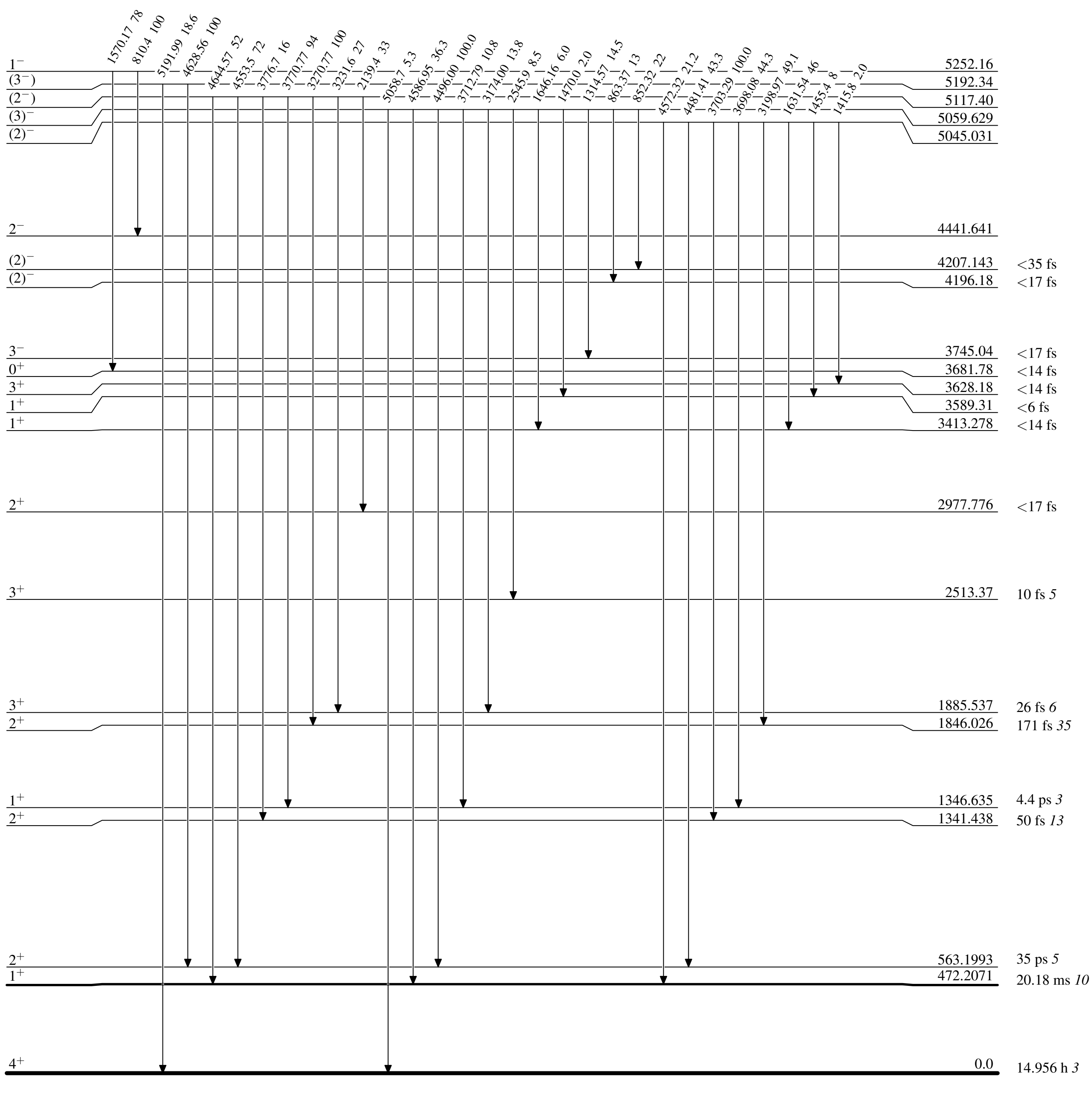
Intensities: Relative photon branching from each level



Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level

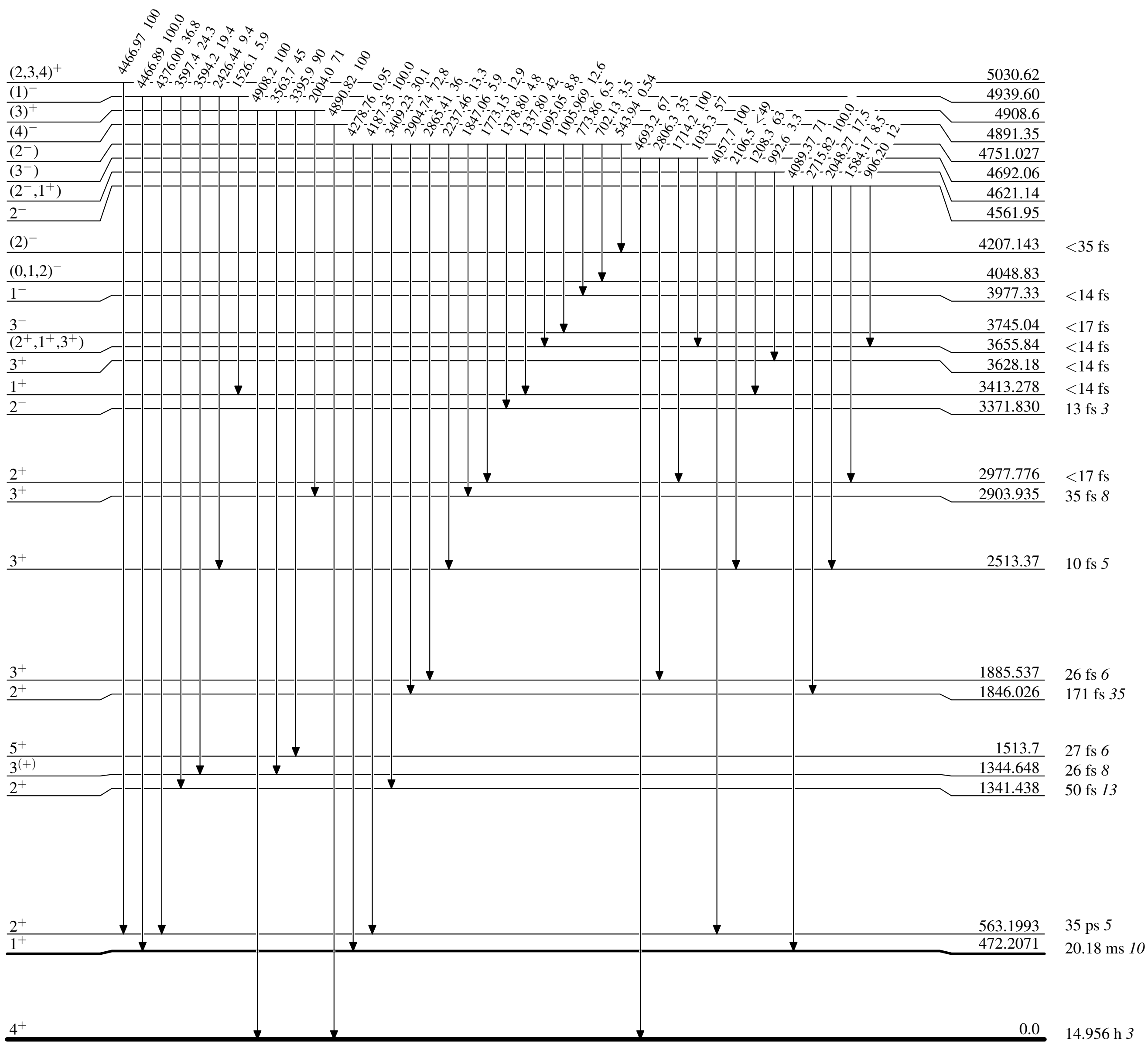


$^{24}_{11}Na_{13}$

Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level

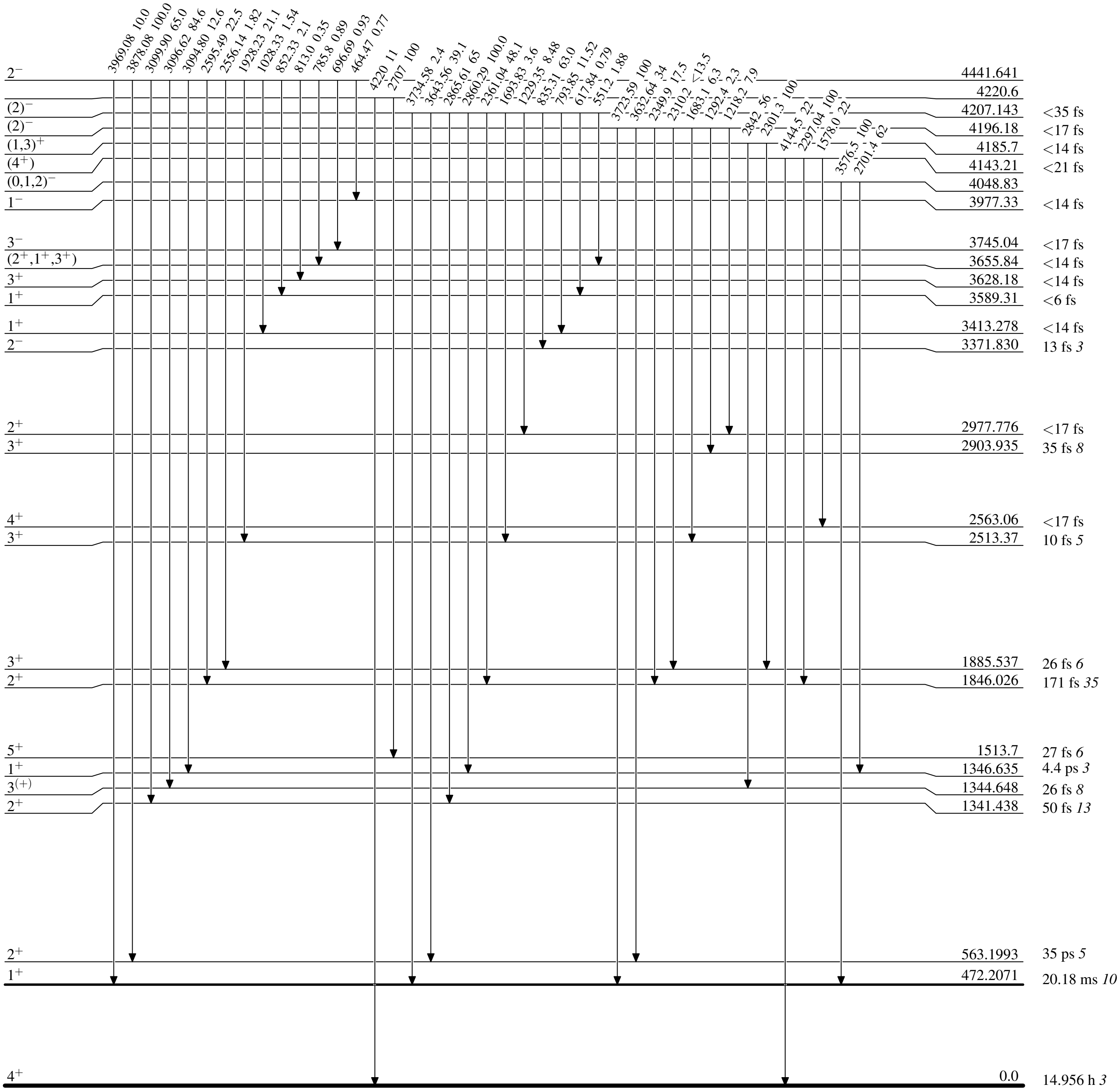


$^{24}_{11}Na_{13}$

Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level

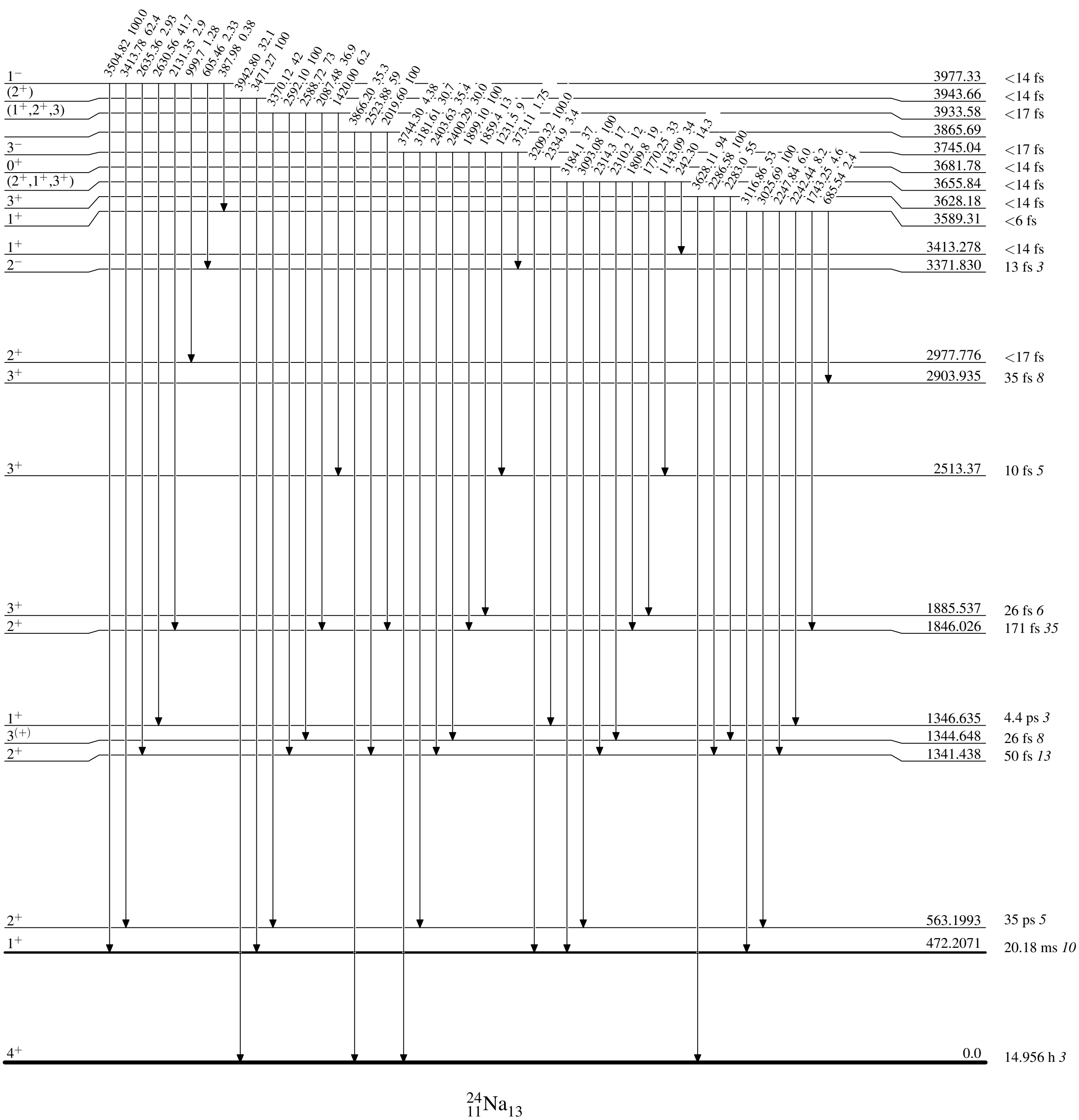


$^{24}_{11}Na_{13}$

Adopted Levels, Gammas

Level Scheme (continued)

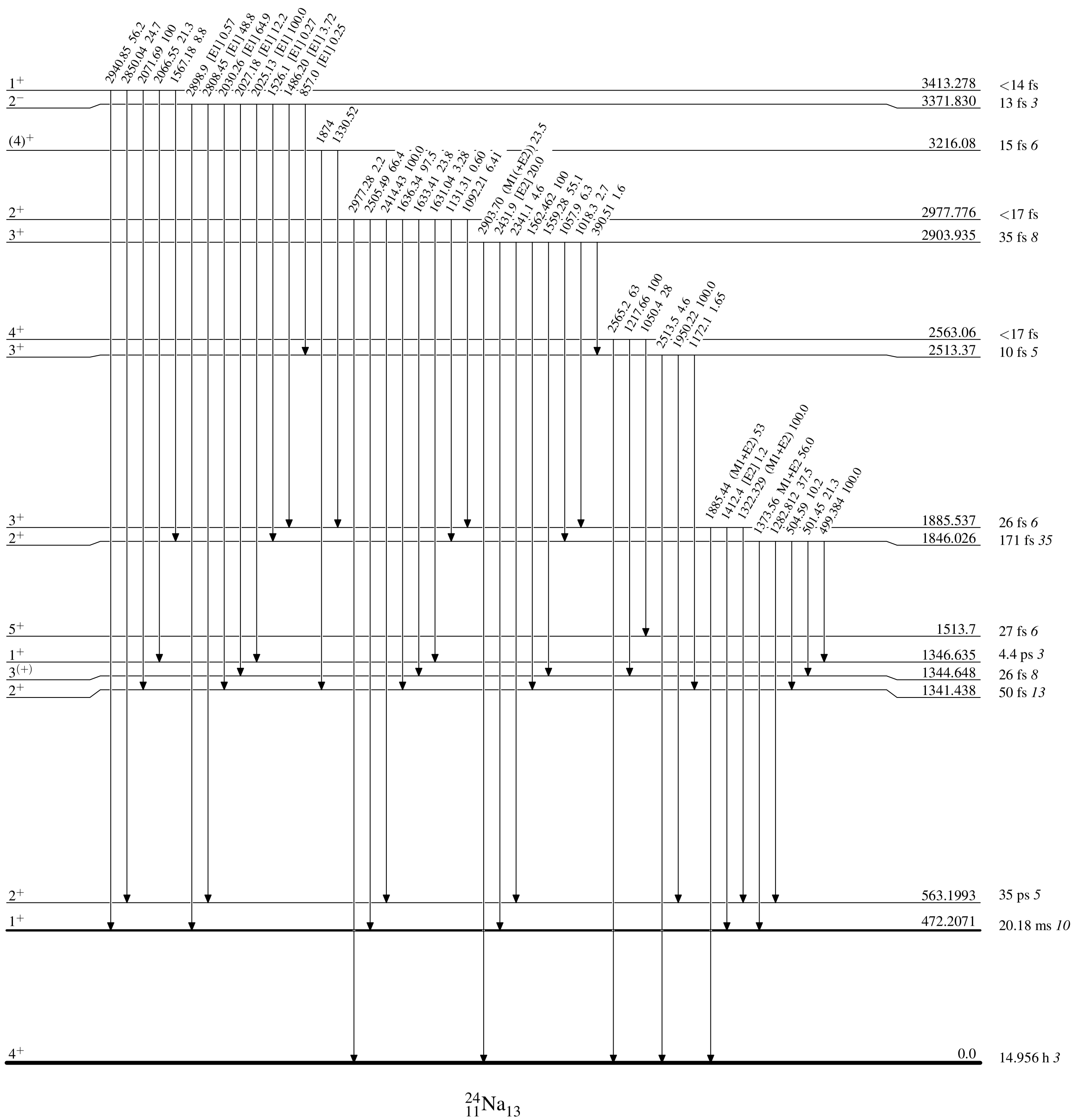
Intensities: Relative photon branching from each level



Adopted Levels, Gammas

Level Scheme (continued)

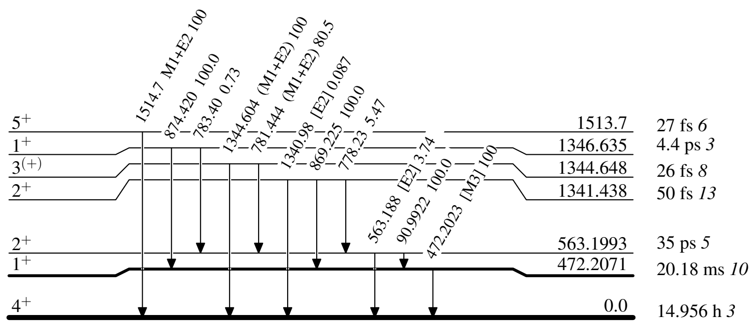
Intensities: Relative photon branching from each level



Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level



$^{24}_{11}Na_{13}$