Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	E. Browne, J. K. Tuli	NDS 114, 1849 (2013)	31-Dec-2012

Q(β^-)=2822.81 *21*; S(n)=7491.92 *7*; S(p)=8274.53 *38*; Q(α)=−7163.79 *38* 2012Wa38
Additional information 1.

Other reactions:
^{63}Cu(n,α) E=20 MeV, calculated σ (2011Pa03).
^{63}Cu(n,α) E=14.9 MeV, Measured σ (2007Zh34).
^{63}Cu(n,α) E=9, 11 MeV. Measured angle-integrated cross section. Model calculations. Inferred level density parameters (1987Ah01). Theoretical interpretation of the total (n,α) cross section below 20 MeV.
^{60}Ni(n,p) E<20 MeV, Calculated σ (2011Pa01).
^{60}Ni(n,p) E=100 MeV/nucleon, calculated Gamow-Teller strengths (2012Co16).
^{60}Ni(n,p) E=14 MeV, measured σ (2011Zh04).
^{60}Ni(n,p), measured fission spectrum, deduced σ (2010El02).
^{60}Ni(n,p) E<20 MeV, calculated excitation function (2009La04).
^{60}Ni(n,p) E=0-20 MeV, calculated σ (2004Fa02).
^{59}Co(n,γ) E=thermal (2012Sh06).
^{59}Co(n,γ), deduced yields (2010Kr02).
^{59}Co(n,γ) E=1 GeV, deduced yields (2010Kr06).
^{59}Co(n,γ), measured Eγ, Iγ, deduced σ (2010Le01).
^{59}Co(n,γ), measured Eγ, Iγ, deduced reaction rates (2009Ti09).
^{59}Co(n,γ) E<20 MeV, calculated σ (2009Zh02).
^{59}Co(n,γ) E<25 keV, measured σ (2008He01).
^{59}Co(n,γ), deduced γ-ray emission probabilities (2004Ma76).
^{59}Co(d,pγ) E=3-40 MeV, Measured Eγ, Iγ (2011Di16).
^{59}Co(d,p) E=7.5 MeV, (2009Vo02).
^{59}Co(d,p) E=7.5-10 MeV, measured σ (2007Vo08).
Zn(p,X) E=31-141 MeV, measured σ (2005Bo10).
Ge(p,X) E=100 MeV, measured σ (2010Ba16).
Zn(p,X) E=26-67 MeV, measured σ (2005Ta01).
Ni(p,X) E=140-500 MeV, measured σ (2006Si27).
Ni(p,X) E=46-2605 MeV, deduced σ (2011Ti04).
^{76}Ge(n,X) E=10-2000 MeV, calculated σ (2010El09).
Ge, Mo, Te(p,X) E=0.8, 1.85 GeV, measured σ (2005No04).
Ni, Cu(n,X) E=0.1-750 MeV, measured σ (2005Si32).
Ni(D.X) E<50 MeV, measured σ activation (2007Ta14).
Cu(d,X) E=3-50 MeV, measured excitation functions (2006Ta21).
^{58}Fe(^{6}Li,X), ^{57}Fe(^{7}Li,X) E=15 MeV, deduced level densities (2009Og06).
Cu(^{7}Li,X) E=35 MeV, measured σ (2004De41).
^{60}Ni(^{13}C,^{13}N) E=100 MeV/nucleon, measured σ (2003Is17,2002Ic01).
^{60}Co(ν,ν') E=0-50 MeV, calculated inelastic σ (2005Ju02).
Protons (E=43-2605 MeV) on W and ^{181}Ta. Measured σ (2011Ti05).
Others: 2004Fe04, 2004Se01, 2003Ya20.
Nuclear Structure.
Calculated level densities (2006Hi10,2005Na24,2002Be89).
Analyzed level densities (2006Su20).
Calculated single-particle level energies (2002Be59).
Nuclear level density (2011Hi13,2007Al51).
Strength functions of dipole γ rays (2008Su11).
Nuclear level density below the binding energy (2010Su17).
Analyzed neutron pairing interaction (2007Fr23).

Adopted Levels, Gammas (continued)

Others: 2007Li49, 2007Li42, 2007Na31, 2005Su21, 2004Ho08, 2003Zh30.
Radioactive decay.
Analyzed measured half-lives (2012Fi12).
Experimental nuclear data of medical isotopes (2012Ja04).
Discovery of Co isotopes (2010Sz02).
Compilations.
$^{59}Co(n,\gamma)$ E=thermal, measured prompt Eγ, Iγ (2002Re13).
^{60}Co evaluated half-life, calculated average γ-ray energy (2011Ch51).
^{60}Co compiled half-life values (2004Wo02).

Some L-values and arguments for J^{π} assignments

E(level)	L(d,p)	L(d,^{3}He)	(pol n,γ)&	Other	Adopted
Target J^{π}=	$7/2^{-}$	$3/2^{-}$	$7/2^{-}$		
0	1	3	5	a	5^{+}
58	1	3	2	b	2^{+}
277	3+1		4		4^{+}
288	3+1	3	3		3^{+}
435	3	(3)	5		5^{+}
506	1	3	3		3^{+}
542	3+1	(3)	2		2^{+}
614	1	3	3		3^{+}
738	3		1		1^{+}
785	1	3	4		4^{+}
1003			(3,4)		(3,4)
1005	1?	3?	4		4
1150			(2,3)	e	$(2^{+},3^{+})$
1207	1		5		5^{+}
1216.45				f	6^{+}
1216.85	3+1?		4		4
1341	1		2,3	h	3^{+}
1379.74				f	6^{+}
1380.97	3+1?		3	d	3^{+}
1451	1		4		4^{+}
1508	(3)		2,3	d	$2^{+},3^{+}$
1510				f	7^{+}
1515	1		4		4^{+}
1565			2		2
1639	3+1		3,4,5		$3^{+},4^{+},5^{+}$
1686			1	d	1^{+}
1749	1		3		3^{+}
1787	(3+1)		5		$5^{(+)}$
1800	4+2			g	$(6)^{-}$
1808	4+2		2,3,4	h	4^{-}
1830	1		4		4^{+}
1852	1		4		4^{+}
1877			2		2
1888	1		4		4^{+}
1924	1				+
1981	3+1?		4		4
2032	1		2,3		$2^{+},3^{+}$
2121	(1)		3,4		$3^{(+)},4^{(+)}$
2132				g	(7^{-})
2133			3,4		3,4
2183	4?		2,3	d	$2^{+},3^{+}$
2221	(3)		4	d	4^{+}
2280				f	5^{+}
2310	1?		3		3
2423			4		4

2430	0		3,4		$3^-,4^-$
2450			3,4		3,4
2488			5		5
2569			4		4
2598	1		3		3^+
2685	0		3,4		$3^-,4^-$
2709			2,3,4		2,3,4
2718			1	d	1^+
2785			3,4		3,4
2823	4			g	$(8)^-$
2825	4		3,4		$3^-,4^-$
2884				f	5^+
2885	0		(3,4)		$3^-,4^-$
3022			3,4		3,4
3108				f	7^+
3114			3,4		3,4

Arguments for J^π assignments (continued)

E(level) Target J^π=	L(d,p) 7/2$^-$	L(d,^{3}He) 3/2$^-$	(pol n,γ)& 7/2$^-$	Other	Adopted
3186	0				$3^-,4^-$
3283	1?		3,4		3,4
3393	0				$3^-,4^-$
3469				f	7^+
3560				f	5^+
3588	0		3,4		$3^-,4^-$
3622	0				$3^-,4^-$
3646				g	(9)
3674				f	7^+
3690				g	(9)
3780				g	7^+
3841				g	(9)
3871	0		3,4		$3^-,4^-$
4005	0				$3^-,4^-$
4012			3,4		3,4
4040				f	7^+
4067	0				$3^-,4^-$
4156	0		3,4		$3^-,4^-$
4212			3,4		3,4
4270	0+2		3,4		$3^-,4^-$
4277				g	10
4365	0				$3^-,4^-$
4390	0+2				$3^-,4^-$
4550				f	7^+
4698	0				$3^-,4^-$
4700				f	7^+
4800				f	7^+
4800.1	0+2		3,4		$3^-,4^-$
4827				g	(11)
4917	0				$3^-,4^-$
5160				g	(11)
6417				g	(12)
7491			3,4	c	$3^-,4^-$
8122				g	(13)

Question marks signify uncertain identification with E(level).
&) From $\gamma(\theta)$ and circ pol with oriented ^{59}Co, see 1978Bo08.

a. J=5 from radiative detection of NMR (1976Fu06).
b. J=2 from atomic beam (1976Fu06).
c. Thermal (n,γ) capture state implies $3^-,4^-$.
d. Parity=+ from L(^{3}He,p) even.
e. Parity=(+) from L(^{3}He,p)=(2).

f. From ^{62}Ni(d,α), (pol d,α) data set.
g. From ^{48}Ca(^{15}N,3nγ) reaction.
h. γ to 5^+ g.s.

^{60}Co Levels

For properties of many resonances in the range E(n)=0-120 keV from ^{59}Co(n,γ), see 1981MuZQ.
Configurations given for the 6^+ and 7^+ levels are from the reaction ^{62}Ni(pol d,α).

$T_{1/2}$(g.s.):
1925.28 d 14 (5.2712 y 4) from weighted average of the following values (values reported in years have been converted to days, 365.242 days/year): 1922.3 d *11* (1963Go03), 1914.6 d *29* (1965An07), 1924.8 d *24* (1968La10), 1914 d *77* (1973Ha60), 1929.6 d *10* (1976Va30), 1925.2 d *4* (1980Ho17), 1924.8 d *10* and 1925.5 d *3* (1982RyZX), 1925.0 d *5* (1983Ru04), 1925.5 d *4* (1983Wa26), and 1925.1 d *5* (1992Un01), 1925.20 d *25* (2002Un02). The Limitation of Relative Statistical Weight method (LWM) has produced a value of 1923.5 d 3. Other evaluated result: 1925.23 d 27 (2004Wo02).

Additional information 2.

$T_{1/2}$(g.s.) Others:
1936 d *256* (1940Li01), 1855 d *29* (1949Se20), 1921 d *62* (1950Br76), 1925 d *26* (1951To25), 1917.5 d *73* (1951Si25), 1903 d *15* (1953Ka21), 1914 d *11* (1957Ge07), 1947 d *15* (1958Ke26), 1807.9 (1953Lo09), 1925.5 d *4* (1970Wa19, replaced by 1983Wa26), and 1929.2 d *26* (1982HoZJ, replaced by 1992Un01).

$T_{1/2}$(g.s.): Several other averages were calculated in order to ascertain how much the result would vary with different analysis methods. The weighted average of the 10 values with uncertainties <4 d is 1925.3 d *4* with a reduced-χ^2=4.6. The Normalized Residual method (1992Ja06) with 20 values (the 19 included above plus that of 1953Lo09) increases the uncertainties of three values and then the weighted average is 1925.2 d *3*. The Rajeval method (1992Ra08) with all 20 values rejects the value of 1953Lo09 and increases the uncertainties of four others, and then the weighted average is 1925.3 d *2*. These values are very consistent, so the result does not depend on the analysis method. The half-life evaluation was done by R. Helmer in conjunction with the Decay Data Evaluation Project (1999BeZS,1999BeZQ).

Cross Reference (XREF) Flags

A	^{59}Co(d,p)	E	^{58}Fe(^{3}He,p)	I	^{61}Ni(d,^{3}He)
B	^{59}Co(n,γ), (pol n,γ) E=th	F	^{48}Ca(^{15}N,3nγ)	J	^{60}Co IT decay
C	^{59}Co(n,γ) E=24 keV	G	^{57}Fe(α,pγ)	K	^{60}Fe β^- decay
D	^{62}Ni(d,α), (pol d,α)	H	^{57}Fe(α,p)	L	^{59}Co(n,γ) E=132 eV

Giant Resonance Studies:
(^{13}C,^{13}N): 2001Ic01, 1993Be19; (^{7}Li,^{7}Be): 2001Na18, 1999Na23;
(π^-,π^0): 1986Er09; (n,p): 1995Wi09
  Isovector (ΔT=1,ΔS=0)
  L=0, isovector electric monopole resonance (IVMR)
    E=20 MeV *2*, Γ=10 MeV *2* (1999Na23,2001Na18),
    E=22.1 MeV *8*, Γ=8.1 MeV *10* (1993Be19) not consistent with L=0,
    E=22.4 MeV *17*, Γ=14.7 MeV *21* (1986Er09),
  L=1(dipole), giant isovector dipole resonance (IVGDR):
    E=8.7 MeV *5*, Γ=2.8 MeV *8* (2002Ic01),
    E=9.1 MeV *3*, Γ=2.2 MeV *4* (1993Be19),
    E=8.5 MeV *5*, Γ=4.0 MeV *5* (1999Na23,2001Na18),
    E=10.7 MeV *16*, Γ=4.2 MeV *20* (1986Er09),
  L=2(quadrupole), giant isovector quadrupole resonance (IVGQR):
    E=20 MeV *2*, Γ=9 MeV *2* (2002Ic01),
  Isovector (ΔT=1,ΔS=1)
  L=1(dipole), spin-dipole resonance (SDR):
    E=9 MeV *1*, Γ=7 MeV *1* (1999Na23,2001Na18),
    E ≈ 12 MeV (1995Wi09)

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Adopted Levels, Gammas (continued)

^{60}Co Levels (continued)

E(level)[†]	J^{π}[f]	$T_{1/2}$[g]	XREF	Comments
0.0	5^+	1925.28 d *14*	ABCDEFGHIJK	%β^-=100 μ=+3.799 *8*; Q=+0.44 *5* μ: From nuclear magnetic resonance (NMR) on oriented nuclei (1972Ni01,1989Ra17,2011StZZ). Q: From nuclear magnetic resonance (NMR) on oriented nuclei; no pol correction included (1972Ni01,1989Ra17,2011StZZ).
58.59 *1*	2^+	10.467 min *6*	ABCDEFG IJK	%IT=99.75 *3*; %β^-=0.25 *3* (1963Sc14) μ=+4.40 *9*; Q=+0.3 *4* $T_{1/2}$: from 1990Ab02. μ,Q: Atomic beam magnetic resonance (1969HuZY,1989Ra17,2011StZZ).
277.20 *2*	4^+		ABCD FG	
288.40 *2*	3^+		ABCDEFG I	
435.71 *4*	5^+		ABCDEFG I	
506.20 *3*	3^+		ABCDEFG I	
542.82 *2*	2^+		ABCDEFG I	
614.55 *2*	3^+		ABCDE G I	
738.80 *2*	1^+		AB DE G	
785.71 *1*	4^+	<3.2 ps	ABCDEFG I	
940? *30*			H	
1003.91 *2*	(3,4)		aBCd G	
1005.80 *2*	4		aBCdE I	
1131.98 *19*			AB D	
1150.70 *5*	$(2^+,3^+)$		ABC E	
1207.83 *3*	5^+		ABC G	
1216.45 *18*	6^+[a]	0.28 ps *+21−14*	AB DEF	
1216.85 *3*	4		BCD G	
1341.86 *3*	3^+		ABC E	
1379.74 *6*	6^+[a]	0.7 ps *3*	aB DEF	
1380.97 *4*	3^+		aBCD	
1451.21 *3*	4^+		ABC	
1508.30 *9*	$2^+,3^+$		AB dE	
1510 *10*	7^+[a]		D	
1515.80 *3*	4^+		a C	
1565.94 *3*	2		ABC	
1639.84 *3*	$3^+,4^+,5^+$		ABCD	
≈1669?			A	
1686.21 *5*	1^+		B E	
1709.68 *13*			ABC	
1749.29 *3*	3^+		ABC	
1787.62 *4*	$5^{(+)}$		ABCD	
1800.22 *15*	$(6)^-$	1.7 ps *+14−6*	AB eF	
1808.63 *15*	4^-		ABC e	
1830.80 *2*	4^+		ABC	
1833.23 *4*			B	
1852.71 *4*	4^+		ABC	
1877.15 *5*	2		BCde	
1888.90 *4*	4^+		ABCde	
1924.29 *21*	+		ABC	
1981.20 *5*	4		ABCdE	
1983.52 *16*			BCd	
2032.71 *11*	$2^+,3^+$		ABC E	
2045.42 *11*			ABCD	
2080.77 *11*			B D	
2121.82 *5*	$3^{(+)},4^{(+)}$		ABCd	
2132.23 *23*	(7^-)	<0.49 ps	A d F	

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Adopted Levels, Gammas (continued)

^{60}Co Levels (continued)

E(level)[†]	Jπ[f]	$T_{1/2}$[g]	XREF
2133.44 *7*	3,4		BCd
2151.9 *3*			ABC
2183.10 *6*	$2^+,3^+$		BC E
2199.9 *3*			ABC
2221.56 *9*	4^+		ABCDE
2230.44 *10*			ABC
2274.67 *16*			ABCd H
2279.94 *20*	5^+		ABCd
2310.15 *6*	3		ABC
2318.4 *10*			A
2324.3 *4*			BC
2341.82 *8*			ABCd
2351.87 *9*			ABCd
2363.96[&] *9*			ABC
2423.28 *10*	4		ABC
2430.97 *10*	$3^-,4^-$		ABC E
2450.87 *15*	3,4		ABCD
2469.72 *24*			AB
2488.71 *9*	5		ABC
2529.00 *15*			ABC
2546 *3*			B
2560.0 *3*			ABC
2569.96 *7*	4		ABC
2585.73 *7*			ABCd
2598.07 *11*	3^+		ABCdE
2607.58 *13*			ABC
2622.07 *15*			BC
2655.71 *19*			ABC
2685.35 *22*	$3^-,4^-$		ABC
2709.97 *20*	2,3,4		ABCd
2718.80 *16*	1		B dE
2734.5 *8*			AB
2760.9 *5*			ABC
2768.13 *25*			ABCD
2771.35 *24*			AB
2785.77 *15*	3,4		AB
2801.6 *3*			AB
2809.7 *4*			AB
2823.2 *5*	$(8)^-$	<0.42 ps	A C F
2825.60 *11*	$3^-,4^-$		B
2845.03 *14*			ABC
2867.57 *12*			ABC
2884 *10*	5^+		D
2884.92 *8*	$3^-,4^-$		ABCD
2897.4? *8*			A
2901.81 *9*			BC
2917.6? *8*			A
2920.4 *4*			BC
2936.48 *14*			B
2939.2 *9*			A
2944.2 *3*			ABC
2963.09 *11*			ABC
2996.9 *3*			ABC
3010.1 *3*			ABC
3022.28 *9*	3,4		ABC
3047.5 *6*			ABC
3064.8 *3*			AB
3077.06 *25*			AB
3084.6 *4*			ABC
3096.35 *9*			AB
3108 *10*	7^+[a]		D
3114.1 *6*	3,4		ABC
3121.4 *4*			ABC
3132.2 *3*			AB
3141.47 *13*			BC
3155.49 *19*			ABC
3162.7 *3*			BC
3186.6 *4*	$3^-,4^-$		ABC
3191.00 *8*			BC
3199.3 *9*			A
3203.22 *13*			AB d
3216.24 *18*			B d
3238.5 *3*			B
≈3265			A
3279.46 *13*			BC
3283.81 *17*	3,4		ABCD
≈3314			A
3336.48 *24*			BC
3343.26 *18*			BCD
≈3367			A
≈3393	$3^-,4^-$		A
3415.51 *12*			ABCD
≈3436			A
3460.4 *3*			ABC E
3465.53 *21*			BC
3469 *10*	7^+[a]		D
3496.94 *24*			ABC H
3514.79 *23*			ABC
3529[#] *10*			DE
3560 *20*	5^+		D
3562.09 *24*			AB D
3588.98 *13*	$3^-,4^-$		ABC
3594.92 *22*			BC E
≈3622	$3^-,4^-$		A
3646.6 *5*	(9)	<0.35 ps	F
3650.4 *4*			AB e
3674[#] *10*	7^+[a]		A De
3690.5 *7*	(9)	<0.28 ps	A F
3696.9 *4*			AB
≈3721			A
3742.44 *16*			ABC
3780[#] *20*	7^+[a]		A D
3797.98 *17*			AB
3827.6 *3*			ABC
3841.2 *6*	(9)	<0.35 ps	A F
3871.1 *6*	$3^-,4^-$		AB H
3914.8 *8*			BC
3928.0 *9*			AB
≈3949			A
≈3987			A
≈4005?	$3^-,4^-$		A
4012.16 *16*	3,4		B

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Adopted Levels, Gammas (continued)

^{60}Co Levels (continued)

E(level)[†]	Jπ[f]	$T_{1/2}$[g]	XREF
≈4024			A
4040[#] *30*	7^+[a]		D
≈4049			A
≈4067	$3^-,4^-$		A
≈4085			A
4100.97 *21*			B
4112.5 *4*			ABC
≈4134			A
4156.57[&] *18*	$3^-,4^-$		AB
≈4166			A
4194.0 *4*			AB
≈4206?			A
4212.8 *7*	3,4		B
4253.9 *3*			AB
4270.02 *24*	$3^-,4^-$		AB
4277.0 *6*	(10)	0.1 ps *6*	D F
4280 *30*			D
4292.05 *12*			AB
4297.8 *4*			B
≈4307			A
≈4325			A
≈4341			A
≈4365[‡]	$3^-,4^-$		A E
≈4390	$3^-,4^-$		A
≈4408			A
≈4420			A
≈4452			A
4485[@] *10*			A E
≈4507?[b]			A
4514.0 *4*			B
≈4523?[b]			A
4540.7 *12*			A H
4550 *30*	7^+[a]		D
≈4563			A
≈4594?[‡c]			AB
4600.97 *17*			B
≈4610?[‡c]			A E
≈4626			A
≈4668			A
≈4698[‡]	$3^-,4^-$		A
4700 *30*	7^+[a]		D
≈4713			A
4752.33 *12*			AB
≈4773			A
≈4786			A
4800 *30*	7^+[a]		D
4800.1 *3*	$3^-,4^-$		AB
4811.3 *5*			AB
4827.5 *7*	(11)	<0.28 ps	F
≈4841			A
≈4864			A
4874.2 *9*			AB
≈4893			A
≈4917	$3^-,4^-$		A
≈4932			A
≈4965			A
≈4980			A
≈4995			A
≈5014			A
≈5031			A
≈5057			A
≈5083			A
≈5098			A
≈5113			A
≈5133			A
≈5146			A
5160.8 *6*	(11)	<0.28 ps	A F
≈5189			A
≈5202			A
≈5243			A
≈5271			A
≈5291			A
≈5306			A
≈5326			A
≈5350			A
≈5372			A
≈5394			A
≈5411			A
≈5424			A
≈5440			A
≈5456			A
≈5471			A
≈5488			A
≈5529			A
≈5545			A
≈5560			A
5575.6 *8*		<0.14 ps	A F
≈5591			A
≈5610			A
≈5638			A
≈5655			A
≈5670			A
≈5684			A
≈5705			A
≈5731			A
≈5750			A
≈5773			A
≈5809			A
≈5822			A
≈5838			A
≈5852			A
≈5871			A
≈5889			A
≈5928			A
≈5943			A
≈5955			A
≈5973			A
≈5987			A
≈5999			A
≈6013			A

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{60}Co Levels (continued)

E(level)[†]	XREF	E(level)[†]	J^{π}[f]	$T_{1/2}$[g]	XREF
≈6027	A	≈6198			A
≈6047	A	6417 *1*	(12)	<0.14 ps	F
≈6066	A	7.05×10^3 *5*			H
≈6088	A	(7491.92[d] *8*)	$3^-,4^-$		B
≈6104	A	≈7514[e]			C
≈6129	A	7.79×10^3 *4*			H
≈6146	A	8122.4 *17*	(13)	<0.35 ps	F
≈6165	A	8.69×10^3 *15*			H
≈6180	A				

† Levels connected by γ′s are from adopted gammas, using least-squares fit, except as noted. An uncertainty of 10 ppm has been added to account for uncertainty in calibration.
‡ From ^{59}Co(d,p).
# From ^{62}Ni(d,α).
@ From ^{58}Fe(^{3}He,p).
& From ^{59}Co(n,γ), (pol n,γ).
a Configuration=^{62}Ni⊗(p $1f_{7/2})^{-1}$.
b May correspond to 4514 keV.
c May correspond to 4601 keV.
d Thermal capture state.
e From (n,γ) E=24 keV.
f See separate table. For tentative assignments of high-spin states, see ^{48}Ca(^{15}N,3nγ).
g From DSA with ^{48}Ca(^{15}N,3nγ), except as noted.

Adopted Levels, Gammas (continued)

$\gamma(^{60}Co)$

δ values in comments are taken from ^{57}Fe(α,pγ), except as noted. For alternative values see ^{59}Co(n,γ), (pol n,γ).

E_i(level)	J^π_i	E_γ[‡]	I_γ[#]	E_f	J^π_f	Mult.[@]	δ	α[†]	Comments
58.59	2+	58.603[b] *7*	100	0.0	5+	M3+(E4)[b]	<0.02[b]	47.3	B(M3)(W.u.)=3.9 α(K)=39.4 *6*; α(L)=6.86 *12*; α(M)=0.966 *16*; α(N+..)=0.0310 *5* α(N)=0.0310 *5* ce(N)/(γ+ce)=0.000641 *13*
277.20	4+	277.08 *3*	100	0.0	5+	(M1+E2)		0.007 *5*	α=0.007 *5*; α(K)=0.006 *4*; α(L)=0.0006 *4*; α(M)=9.E−5 *6*; α(N+..)=3.8×10^{-6} *22* α(N)=3.8×10^{-6} *22* δ: +0.02 *6* or ≤−12.
288.40	3+	229.72 *4*	100	58.59	2+	(M1+E2)		0.014 *9*	α(K)=0.012 *8*; α(L)=0.0012 *8*; α(M)=0.00017 *12*; α(N+..)=7.E−6 *5* α(N)=7.E−6 *5* δ: +0.04 *+4−5* or −3.7 *+12−7*.
435.71	5+	158.46 *5*	100.0 *7*	277.20	4+	(M1+E2)		0.05 *4*	α(K)=0.05 *4*; α(L)=0.005 *4*; α(M)=0.0007 *5*; α(N+..)=2.7×10^{-5} *20* α(N)=2.7×10^{-5} *20* δ: +0.06 *4* or −4.8 *+9−13*.
		435.71 *5*	64.0 *13*	0.0	5+	(M1+E2)		0.0017 *7*	α=0.0017 *7*; α(K)=0.0015 *6*; α(L)=0.00015 *6*; α(M)=2.1×10^{-5} *8*; α(N+..)=9.E−7 *4* α(N)=9.E−7 *4* δ: +0.5 *+4−3* or −0.1 *3*.
506.20	3+	217.88 *20*	0.53 *5*	288.40	3+				
		447.68 *9*	100.0 *13*	58.59	2+	(M1+E2)		0.0016 *6*	α=0.0016 *6*; α(K)=0.0014 *6*; α(L)=0.00014 *6*; α(M)=1.9×10^{-5} *8*; α(N+..)=8.E−7 *3* α(N)=8.E−7 *3* δ: +0.06 *7* or −4.3 *+10−18*.
542.82	2+	254.23 *5*	100.0 *19*	288.40	3+	(M1+E2)		0.010 *6*	α=0.010 *6*; α(K)=0.009 *6*; α(L)=0.0009 *6*; α(M)=0.00012 *8*; α(N+..)=5.E−6 *3* α(N)=5.E−6 *3* δ: +0.02 *12* or −6 *+2−6*.
		484.21 *3*	61.5 *7*	58.59	2+				
614.55	3+	337.32 *7*	3.68 *10*	277.20	4+				
		555.969 *12*	100.0 *9*	58.59	2+	(M1+E2)		0.00084 *24*	α=0.00084 *24*; α(K)=0.00076 *22*; α(L)=7.4×10^{-5} *21*; α(M)=1.0×10^{-5} *3*; α(N+..)=4.5×10^{-7} *13* α(N)=4.5×10^{-7} *13* δ: −0.03 *6* or −2.8 *+4−7*.
738.80	1+	195.84 *5*	70.7 *11*	542.82	2+				
		680.210 *13*	100.0 *16*	58.59	2+				
785.71	4+	171.3 *3*	2.3 *4*	614.55	3+				
		349.87 *8*	4.33 *14*	435.71	5+				
		497.275 *18*	83.7 *6*	288.40	3+	(M1+E2)		0.0012 *4*	α=0.0012 *4*; α(K)=0.0010 *4*; α(L)=0.00010 *4*; α(M)=1.4×10^{-5} *5*; α(N+..)=6.2×10^{-7} *20*

Adopted Levels, Gammas (continued)

$\gamma(^{60}Co)$ (continued)

E_i(level)	J^π_i	E_γ[‡]	I_γ[#]	E_f	J^π_f	Mult.[@]	α[†]	Comments
								α(N)=6.2×10^{-7} *20* δ: −0.08 *9* or −2.4 *+5−6*.
785.71	4$^+$	785.724 *10*	100.0 *14*	0.0	5$^+$	(M1+E2)[&]	0.00035 *6*	α=0.00035 *6*; α(K)=0.00031 *5*; α(L)=3.0×10^{-5} *5*; α(M)=4.2×10^{-6} *7*; α(N+..)=1.9×10^{-7} *3* α(N)=1.9×10^{-7} *3* δ: +0.10 *+20−10* from ^{59}Co(n,γ), (pol n,γ).
1003.91	(3,4)	461.04 *3*	52.6 *4*	542.82	2$^+$			
		715.38 *8*	4.8 *4*	288.40	3$^+$			
		726.709 *13*	48.2 *7*	277.20	4$^+$			
		945.321 *17*	100 *2*	58.59	2$^+$			
1005.80	4	220.00 *11*	3.58 *14*	785.71	4$^+$			
		391.221 *21*	100.0 *7*	614.55	3$^+$	D+Q		δ: +0.08 *6* or −4.8 *+11−21*.
		717.415 *10*	78.3 *10*	288.40	3$^+$			
		1005.69 *4*	12.3 *5*	0.0	5$^+$			
1131.98		393.18 *19*	100	738.80	1$^+$			
1150.70	(2$^+$,3$^+$)	862.30 *4*	100	288.40	3$^+$			
1207.83	5$^+$	930.614 *17*	100.0 *18*	277.20	4$^+$			
		1207.96 *7*	40 *4*	0.0	5$^+$			
1216.45	6$^+$	779.91[cd] *16*	35[c] *7*	435.71	5$^+$			
		1216.44 *18*	100	0.0	5$^+$			
1216.85	4	710.648 *10*	100.0 *13*	506.20	3$^+$			
		928.42 *3*	23.8 *7*	288.40	3$^+$			
1341.86	3$^+$	799.03 *3*	54.0 *15*	542.82	2$^+$			
		1283.27 *3*	100 *3*	58.59	2$^+$			
		1341.2 *3*	6.7 *19*	0.0	5$^+$			
1379.74	6$^+$	172.1 *4*	19 *6*	1207.83	5$^+$			
		944.05 *5*	100 *6*	435.71	5$^+$			
1380.97	3$^+$	1103.76 *3*	100	277.20	4$^+$			
1451.21	4$^+$	665.52 *4*	71 *3*	785.71	4$^+$			
		908.37 *3*	100 *4*	542.82	2$^+$			
1508.30	2$^+$,3$^+$	1002.09 *8*	100	506.20	3$^+$			
1515.80	4$^+$	901.282 *15*	17.1 *3*	614.55	3$^+$			
		1238.561 *22*	12.0 *3*	277.20	4$^+$			
		1515.748 *14*	100 *3*	0.0	5$^+$			
1565.94	2	224.1 *3*	14.9 *21*	1341.86	3$^+$			
		1277.49 *3*	28.2 *9*	288.40	3$^+$			
		1507.348 *23*	100 *3*	58.59	2$^+$			
1639.84	3$^+$,4$^+$,5$^+$	854.147 *22*	100.0 *23*	785.71	4$^+$			
		1362.49 *6*	43.6 *23*	277.20	4$^+$			
1686.21	1$^+$	947.41 *4*	100	738.80	1$^+$			
1709.68		1651.05 *13*	100	58.59	2$^+$			
1749.29	3$^+$	963.57 *3*	54.2 *17*	785.71	4$^+$			

From ENSDF

$^{60}_{27}Co_{33}$-10

$\gamma(^{60}Co)$ (continued)

E_i(level)	J_i^π	E_γ[‡]	I_γ[#]	E_f	J_f^π	Mult.[@]	α[†]	Comments
1749.29	3^+	1206.66 *12*	34 *5*	542.82	2^+			
		1472.01 *3*	94 *3*	277.20	4^+			
		1690.74 *4*	100 *5*	58.59	2^+			
1787.62	$5^{(+)}$	781.81 *3*	100 *3*	1005.80	4			
		1787.4 *3*	43 *15*	0.0	5^+			
1800.22	$(6)^-$	420.86[c] *19*	1.1[c] *11*	1379.74	6^+			
		584.43[c] *10*	6.5[c] *22*	1216.45	6^+			
		1799.70[c] *22*	100.0[c] *22*	0.0	5^+	[E1]	0.000525 *8*	B(E1)(W.u.)=0.41×10^{-4} *24* α=0.000525 *8*; α(K)=3.11×10^{-5} *5*; α(L)=2.97×10^{-6} *5*; α(M)=4.14×10^{-7} *6*; α(N+..)=0.000491 *7* α(N)=1.86×10^{-8} *3*; α(IPF)=0.000491 *7*
1808.63	4^-	1808.37 *18*	100	0.0	5^+			
1830.80	4^+	1553.68 *6*	7.1 *4*	277.20	4^+			
		1830.763 *21*	100 *4*	0.0	5^+			
1833.23		1774.62 *3*	100	58.59	2^+			
1852.71	4^+	1852.678 *25*	100	0.0	5^+			
1877.15	2	1262.56 *10*	17.2 *14*	614.55	3^+			
		1818.54 *5*	100 *6*	58.59	2^+			
1888.90	4^+	883.20 *5*	36.5 *18*	1005.80	4			
		1274.26 *3*	100 *3*	614.55	3^+			
		1889.04 *8*	50 *4*	0.0	5^+			
1924.29	$^+$	1647.06 *21*	100	277.20	4^+			
1981.20	4	1692.78 *4*	100	288.40	3^+			
1983.52		174.91 *5*	100	1808.63	4^-			
2032.71	$2^+,3^+$	824.88 *10*	100	1207.83	5^+			
2045.42		837.62 *14*	53 *7*	1207.83	5^+			
		1539.16 *17*	100 *13*	506.20	3^+			
2080.77		2022.15 *11*	100	58.59	2^+			
2121.82	$3^{(+)},4^{(+)}$	1117.92 *5*	100 *5*	1003.91	(3,4)			
		2121.3 *3*	27 *6*	0.0	5^+			
2132.23	(7^-)	332.54[ac]	100[c] *6*	1800.22	$(6)^-$			
		916.44[c] *14*	22[c] *6*	1216.45	6^+			
2133.44	3,4	1844.98 *9*	70 *5*	288.40	3^+			
		2074.84 *9*	100 *6*	58.59	2^+			
2151.9		1146.1 *3*	100	1005.80	4			
2183.10	$2^+,3^+$	617.15 *5*	100	1565.94	2			
2221.56	4^+	1215.79 *14*	9×10^1 *4*	1005.80	4			
		2221.49 *10*	1.0×10^2 *1*	0.0	5^+			
2230.44		2171.65 *11*	100	58.59	2^+			
2274.67		1986.24 *16*	100	288.40	3^+			
2279.94	5^+	2279.89 *20*	100	0.0	5^+			
2310.15	3	2032.91 *4*	100	277.20	4^+			

$^{60}_{27}Co_{33}$-11

Adopted Levels, Gammas (continued)

$\gamma(^{60}Co)$ (continued)

E_i(level)	J^π_i	E_γ‡	I_γ#	E_f	J^π_f
2324.3		2265.7 4	100	58.59	2^+
2341.82		1556.09 8	100	785.71	4^+
2351.87		1134.75 13	26 3	1216.85	4
		1809.53 24	1.0×10^2 4	542.82	2^+
2423.28	4	1419.35 7	100	1003.91	(3,4)
2430.97	$3^-,4^-$	297.55 8	100 3	2133.44	3,4
		2430.85 24	57 8	0.0	5^+
2450.87	3,4	370.09 10	100	2080.77	
2469.72		2469.6 3	100	0.0	5^+
2488.71	5	1271.91 10	81 7	1216.85	4
		1982.34 17	96 11	506.20	3^+
		2210.8 7	28 12	277.20	4^+
		2488.59 21	100 12	0.0	5^+
2529.00		728.753 23	100 3	1800.22	$(6)^-$
		2240.5 8	11 5	288.40	3^+
2560.0		2501.3 3	100	58.59	2^+
2569.96	4	2063.82 11	39 3	506.20	3^+
		2281.75 15	79 10	288.40	3^+
		2569.68 11	100 6	0.0	5^+
2585.73		233.89 11	14.8 7	2351.87	
		1069.92 11	20.2 20	1515.80	4^+
		2527.04 11	100 7	58.59	2^+
2598.07	3^+	2309.63 11	100	288.40	3^+
2607.58		2607.52 13	100	0.0	5^+
2622.07		589.35 11	100	2032.71	$2^+,3^+$
2655.71		1504.99 18	100	1150.70	$(2^+,3^+)$
2685.35	$3^-,4^-$	2249.71 22	100	435.71	5^+
2709.97	2,3,4	2203.73 19	100	506.20	3^+
2760.9		2472.4 5	100	288.40	3^+
2768.13		2262.4 4	72 14	506.20	3^+
		2768.4 5	100 17	0.0	5^+
2771.35		1639.35 14	100	1131.98	
2785.77	3,4	2727.11 15	100	58.59	2^+
2801.6		2801.7 4	100	0.0	5^+
2823.2	$(8)^-$	691.0[c] 4	100[c]	2132.23	(7^-)
2825.60	$3^-,4^-$	2319.36 10	100	506.20	3^+
2845.03		1158.85 15	45 6	1686.21	1^+
		2338.6 3	100 17	506.20	3^+
2867.57		2128.71 14	1.0×10^2 1	738.80	1^+
		2361.38 22	82 11	506.20	3^+
2884.92	$3^-,4^-$	2099.21 7	100 6	785.71	4^+
		2884.43 24	87 8	0.0	5^+
2901.81		779.98 7	100	2121.82	$3^{(+)},4^{(+)}$
2920.4		2632.1 4	75 16	288.40	3^+
		2861.2 7	100 23	58.59	2^+
2936.48		1226.79 4	100	1709.68	
2944.2		744.27 6	100	2199.9	
2963.09		532.11 4	100	2430.97	$3^-,4^-$
2996.9		2454.0 3	100	542.82	2^+
3010.1		1176.9 3	100	1833.23	
3022.28	3,4	1382.41 7	100 6	1639.84	$3^+,4^+,5^+$
		2745.7 9	51 13	277.20	4^+
3047.5		2759.0 6	100	288.40	3^+
3064.8		2628.7 5	70 12	435.71	5^+
		3006.2 3	100 11	58.59	2^+
3077.06		2641.29 24	100	435.71	5^+
3084.6		3084.8 6	100	0.0	5^+
3096.35		2357.51 8	100	738.80	1^+
3114.1	3,4	2836.8 6	100	277.20	4^+
3121.4		2831.7 13	44 19	288.40	3^+
		3121.4 4	100 12	0.0	5^+
3132.2		2346.4 6	100	785.71	4^+
3141.47		1924.59 12	100	1216.85	4
3155.49		2866.4 7	42 11	288.40	3^+
		3096.92 20	100 7	58.59	2^+
		3154.1 10	23 7	0.0	5^+
3162.7		602.711 25	100	2560.0	
3186.6	$3^-,4^-$	3127.9 4	100	58.59	2^+
3191.00		827.03 7	100	2363.96	
3203.22		972.50 15	56 3	2230.44	
		2926.31 17	100 8	277.20	4^+
3216.24		3216.15 18	100	0.0	5^+
3279.46		1246.74 8	100	2032.71	$2^+,3^+$
3283.81	3,4	2777.5 3	73 8	506.20	3^+
		2995.30 22	95 8	288.40	3^+
		3284.0 5	100 15	0.0	5^+
3336.48		2899.8 4	85 11	435.71	5^+
		3048.5 3	1.0×10^2 1	288.40	3^+
3343.26		2557.49 18	100	785.71	4^+
3415.51		1334.72 5	100	2080.77	
3460.4		3401.7 3	100	58.59	2^+
3465.53		1677.89 20	100	1787.62	$5^{(+)}$
3514.79		829.45 8	100 8	2685.35	$3^-,4^-$
		3513.6 7	61 14	0.0	5^+
3562.09		1092.347 22	100.0 24	2469.72	
		3503.7 4	13.6 18	58.59	2^+

$^{60}_{27}Co_{33}$-12

γ(^{60}Co) (continued)

E_i(level)	J^π_i	E_γ[‡]	I_γ[#]	E_f	J^π_f
3588.98	3⁻,4⁻	1839.66 *11*	100	1749.29	3⁺
3594.92		1612.3 *3*	17 *4*	1983.52	
		1785.94 *18*	100 *19*	1808.63	4⁻
3646.6	(9)	823.33[c] *20*	100[c]	2823.2	(8)⁻
3650.4		2434.5 *3*	100	1216.45	6⁺
3690.5	(9)	867.3[c] *5*	100[c]	2823.2	(8)⁻
3696.9		1544.99 *12*	100	2151.9	
3742.44		1023.636 *24*	100.0 *24*	2718.80	1
		1542.51 *25*	16 *3*	2199.9	
		1910.4 *4*	11 *3*	1830.80	4⁺
		1933.72 *8*	57 *4*	1808.63	4⁻
		3454.0 *3*	47 *4*	288.40	3⁺
3797.98		2158.12 *17*	100 *11*	1639.84	3⁺,4⁺,5⁺
		3290.3 *13*	47 *13*	506.20	3⁺
3827.6		1059.50 *10*	68 *6*	2768.13	
		3320.6 *4*	100 *13*	506.20	3⁺
3841.2	(9)	1017.94[ac]	100[c]	2823.2	(8)⁻
3871.1	3⁻,4⁻	3328.2 *6*	100	542.82	2⁺
3914.8		3407.9 *9*	100 *25*	506.20	3⁺
		3639.6 *17*	39 *19*	277.20	4⁺
3928.0		2720.1 *9*	100	1207.83	5⁺
4012.16	3,4	1075.67 *7*	100	2936.48	
4100.97		968.74 *22*	21 *5*	3132.2	
		3823.54 *23*	100 *7*	277.20	4⁺
		4043.6 *8*	26 *6*	58.59	2⁺
4112.5		4112.3 *4*	100	0.0	5⁺
4194.0		3651.1 *5*	73 *12*	542.82	2⁺
		3758.1 *5*	100 *14*	435.71	5⁺
4212.8	3,4	3669.9 *7*	100	542.82	2⁺
4253.9		3248.0 *3*	100	1005.80	4
4270.02	3⁻,4⁻	2482.35 *23*	100	1787.62	5⁽⁺⁾
4277.0	(10)	435.76[c] *20*	12[c] *4*	3841.2	(9)
		630.37[c] *10*	100[c] *4*	3646.6	(9)
4292.05		1195.69 *8*	38.7 *25*	3096.35	
		3677.38 *25*	100 *7*	614.55	3⁺
4297.8		2789.4 *4*	100	1508.30	2⁺,3⁺
4514.0		1429.31 *14*	55 *6*	3084.6	
		1704.21 *7*	100 *6*	2809.7	
		2661.1 *4*	36 *7*	1852.71	4⁺
4540.7		3997.7 *12*	100	542.82	2⁺
4600.97		3815.06 *17*	100 *6*	785.71	4⁺
		4312.8 *4*	47 *6*	288.40	3⁺
4752.33		2399.6 *3*	19.0 *25*	2351.87	
		3966.60 *11*	100 *5*	785.71	4⁺
		4245.3 *9*	5.9 *15*	506.20	3⁺
4800.1	3⁻,4⁻	1998.48 *14*	1.0×10² *1*	2801.6	
		3349.2 *6*	44 *8*	1451.21	4⁺
		4799.5 *4*	40 *5*	0.0	5⁺
4811.3		3302.9 *5*	100	1508.30	2⁺,3⁺
4827.5	(11)	550.5[c] *4*	100[c]	4277.0	(10)
4874.2		3493.1 *9*	100	1380.97	3⁺
5160.8	(11)	883.79[c] *11*	100[c]	4277.0	(10)
5575.6		748.1[c] *3*	100[c]	4827.5	(11)
6417	(12)	1256.2[c] *8*	100[c]	5160.8	(11)
8122.4	(13)	2546.8[c] *15*	100[c]	5575.6	

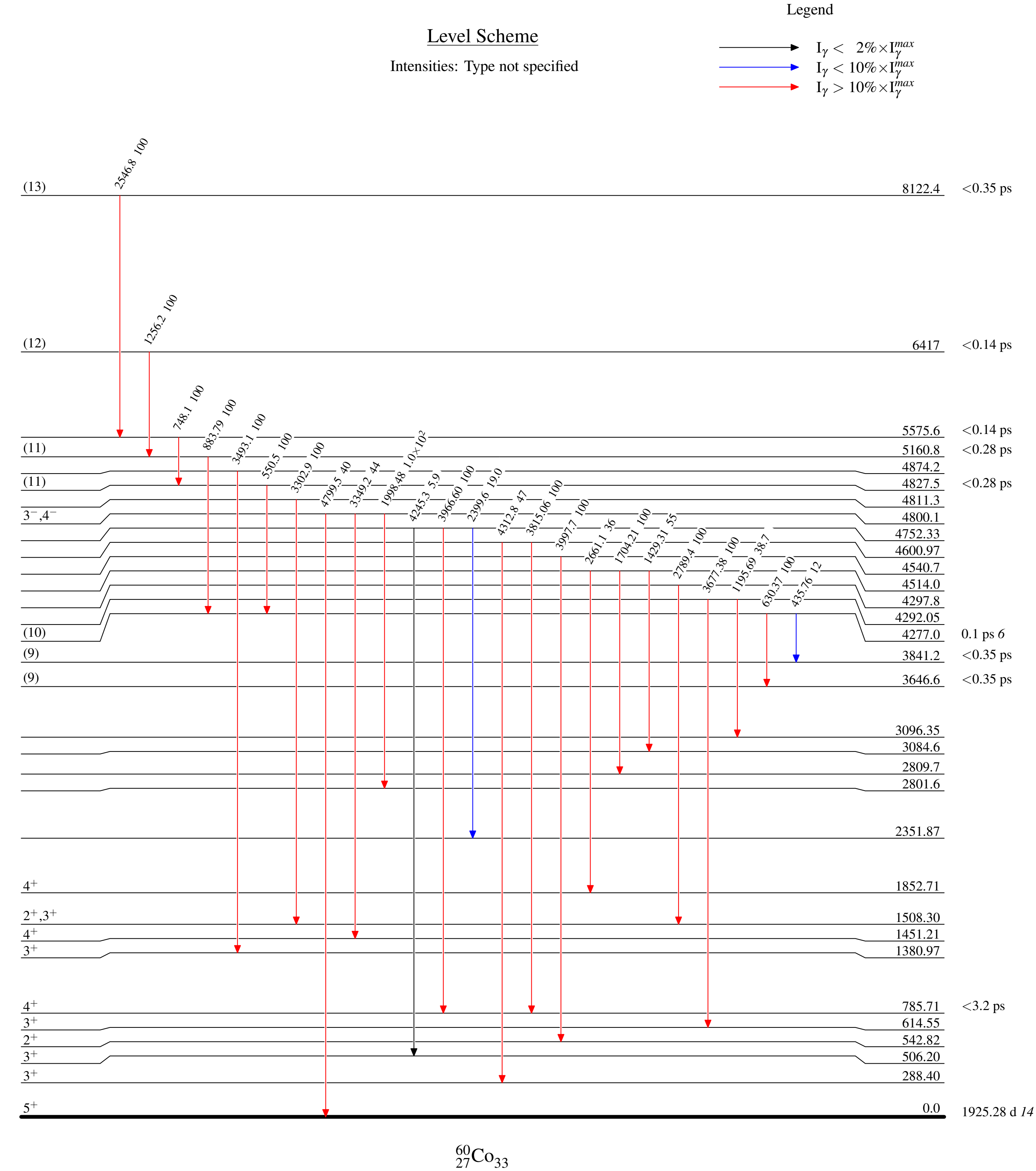
[†] Additional information 3.
[‡] From ^{59}Co(n,γ), (pol n,γ), except as noted. For decay of capture states, see ^{59}Co(n,γ) E=thermal and E=24 keV.
[#] Relative Iγ from each level, taken From ^{59}Co(n,γ), (pol n,γ), except as noted otherwise.
[@] From γ(θ) in ^{57}Fe(α,pγ) and adopted parities, except as noted.
[&] From γ(θ) in ^{59}Co(n,γ), (pol n,γ).
[a] Deduced from level separation. γ not included in energy fit.
[b] From ^{60}Co (10.5 min) IT decay.
[c] From ^{48}Ca(^{15}N,3nγ).
[d] Placement of transition in the level scheme is uncertain.

$^{60}_{27}Co_{33}$-13

Adopted Levels, Gammas

Level Scheme

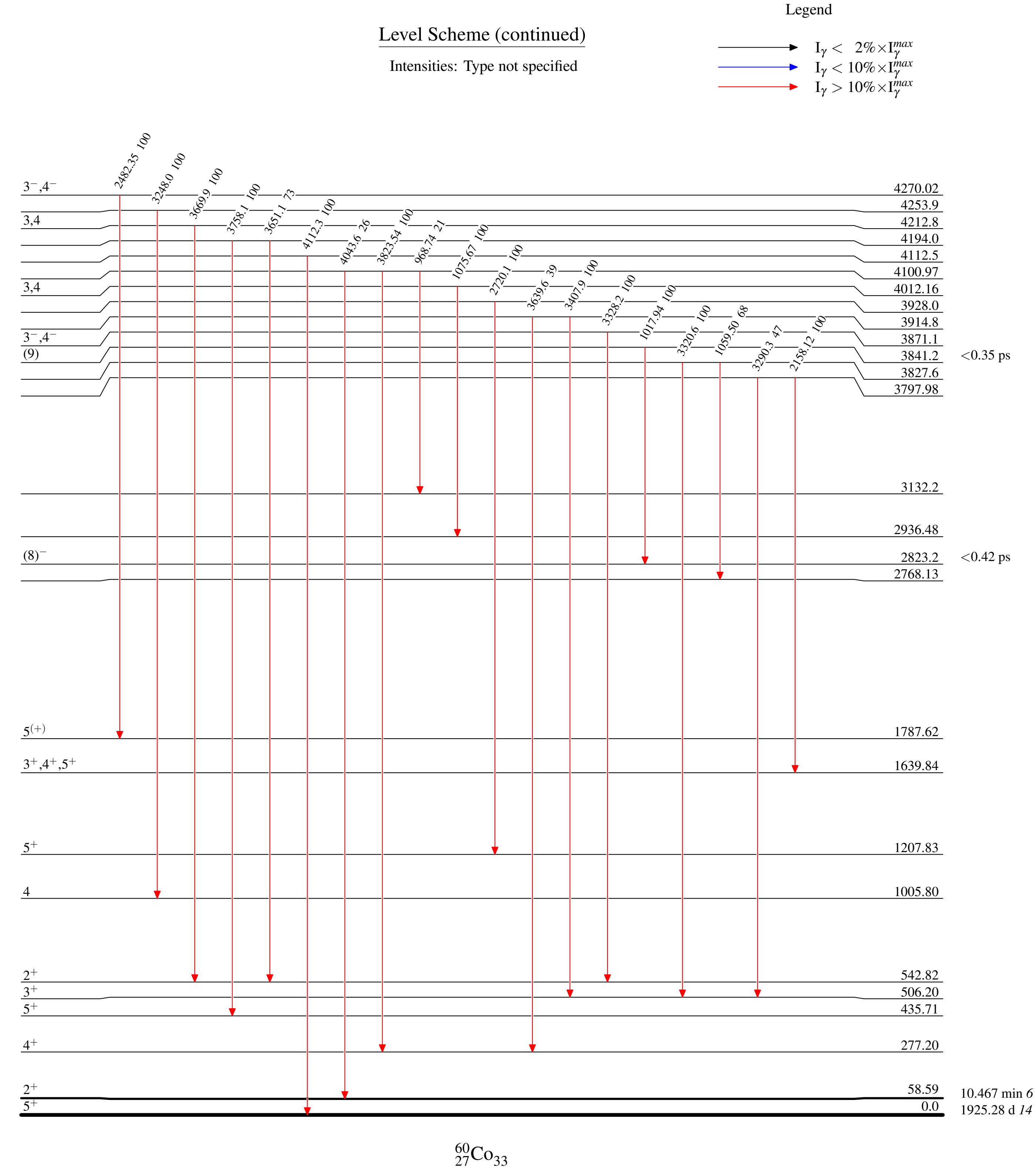
Intensities: Type not specified



Adopted Levels, Gammas

Level Scheme (continued)

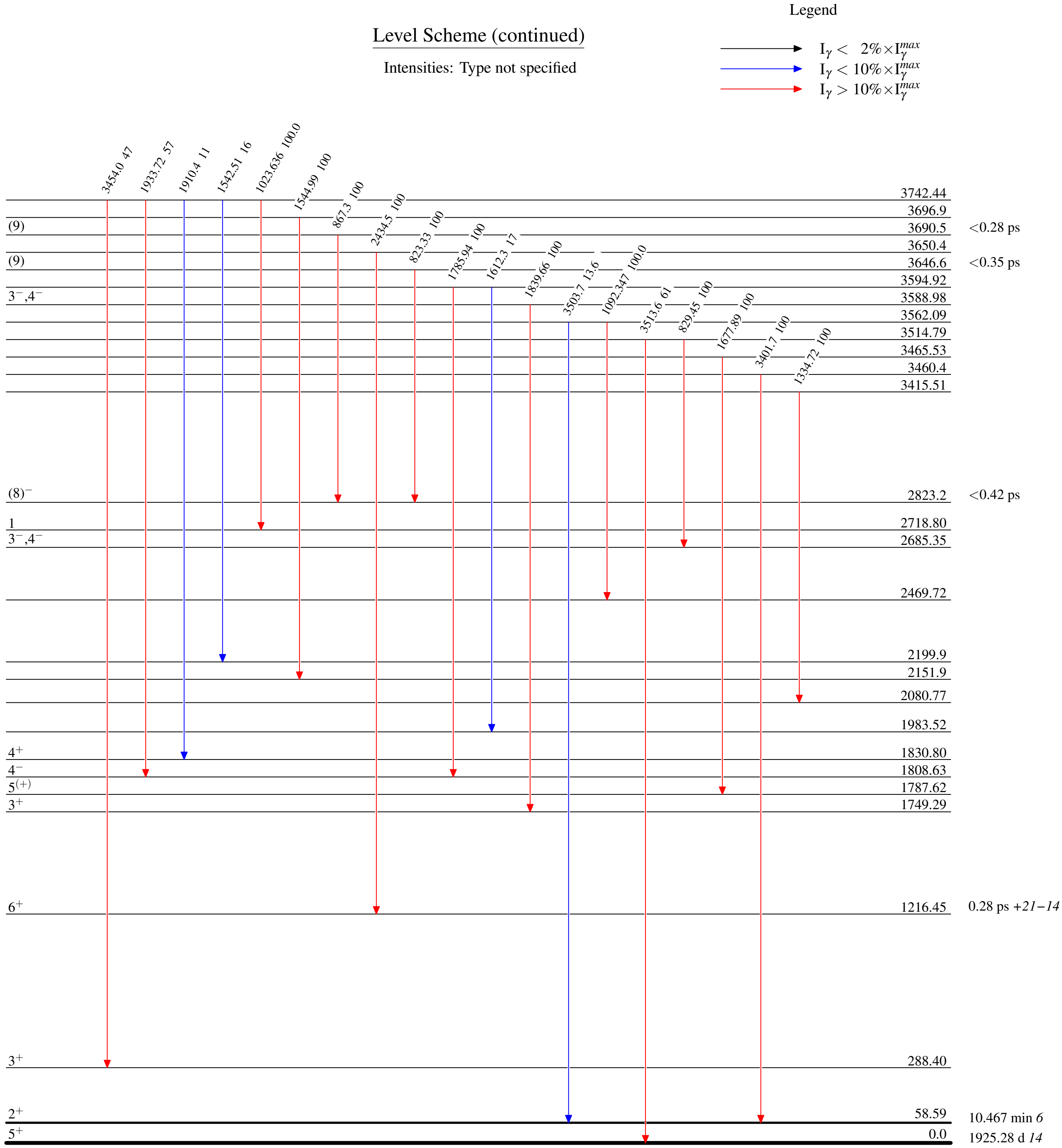
Intensities: Type not specified



Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Type not specified

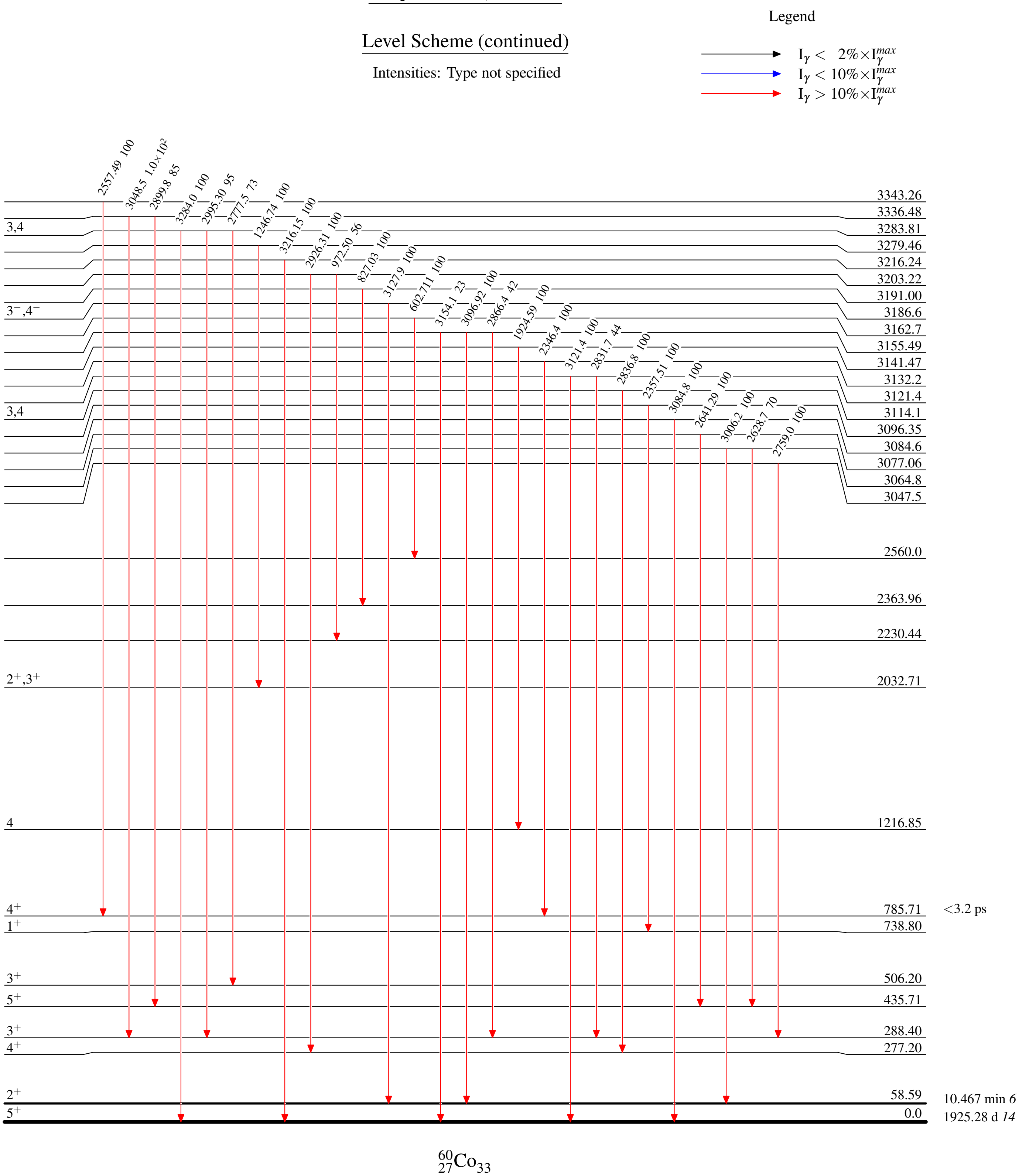


$^{60}_{27}Co_{33}$

Adopted Levels, Gammas

Level Scheme (continued)

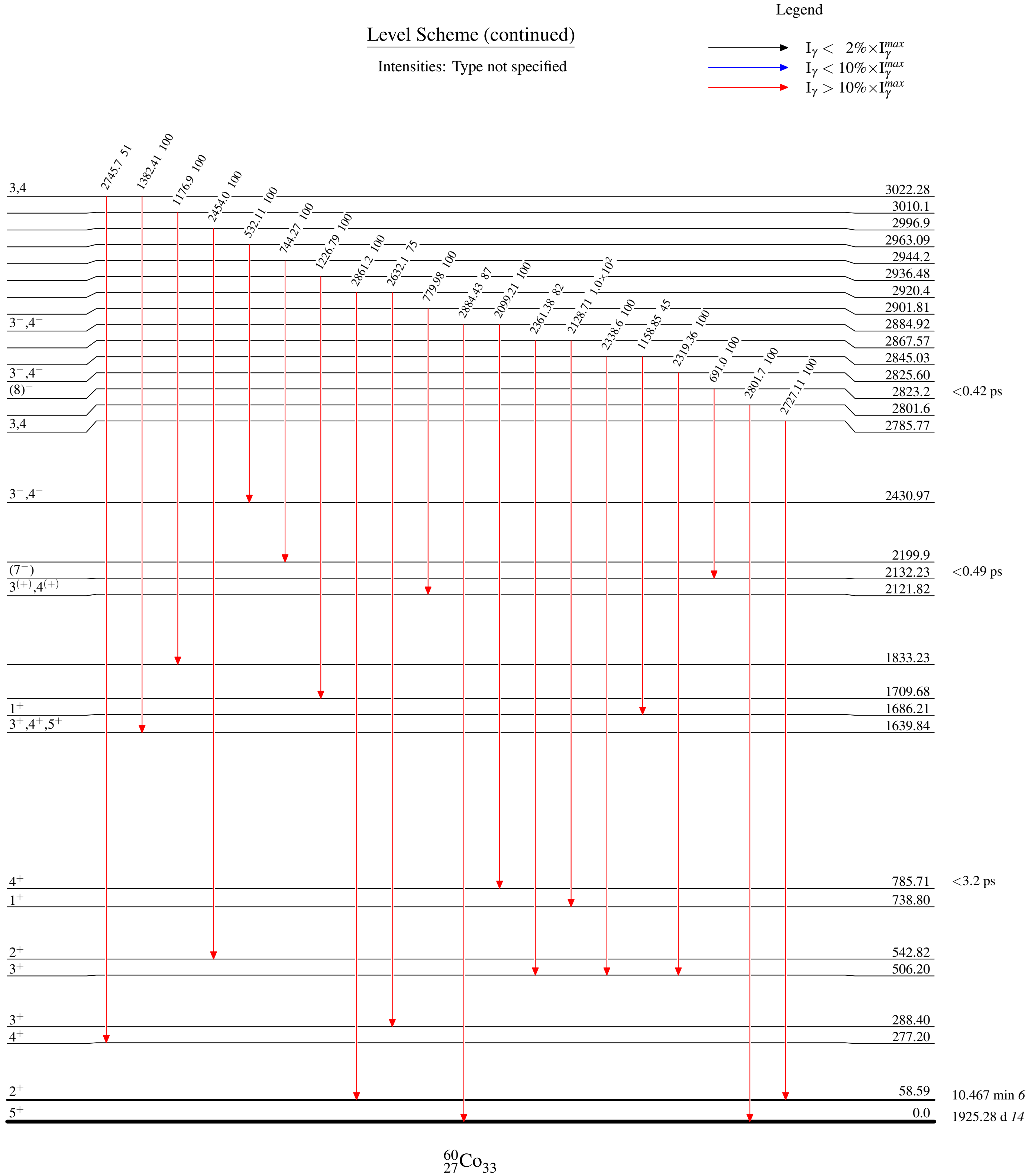
Intensities: Type not specified



Adopted Levels, Gammas

Level Scheme (continued)

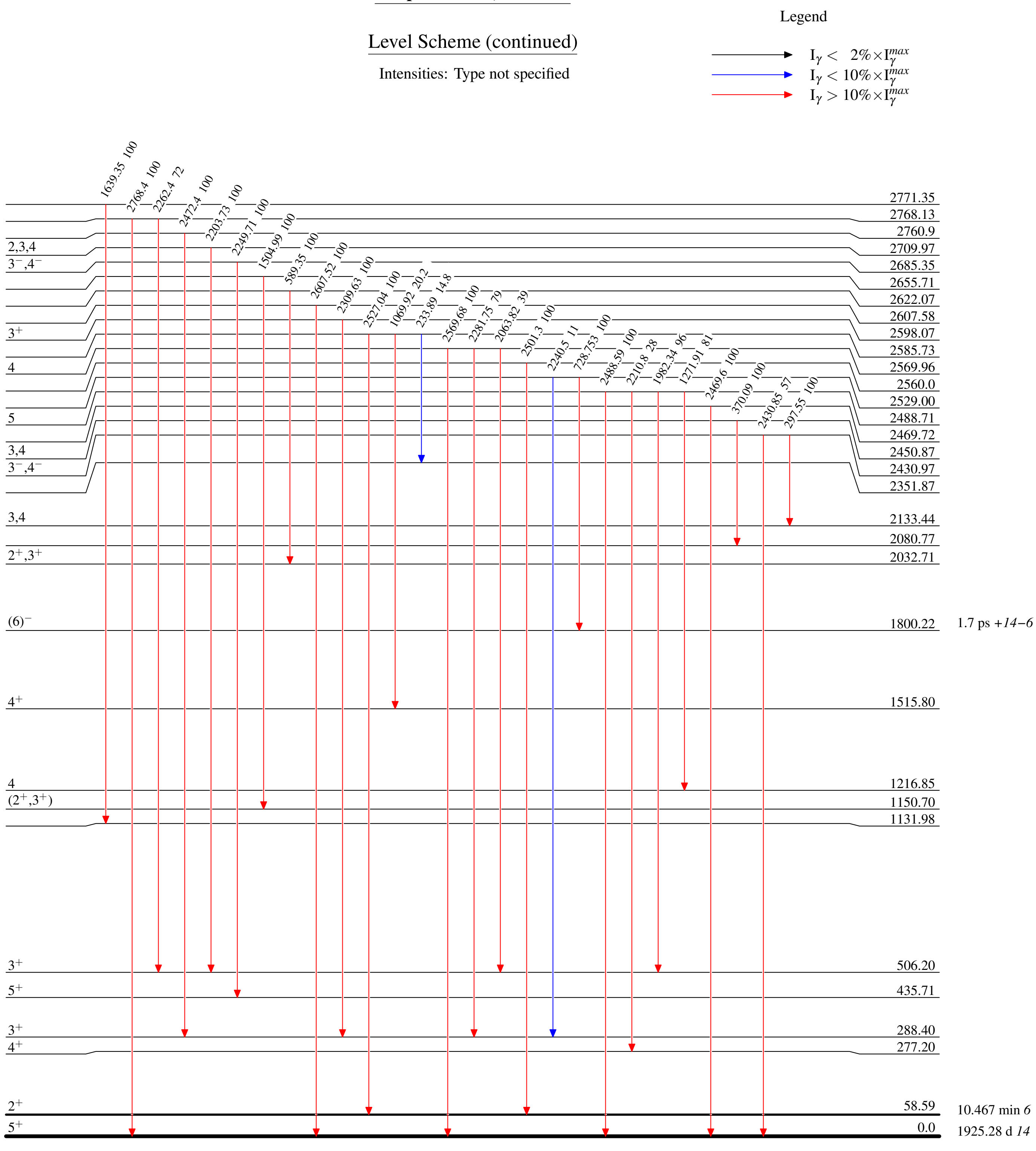
Intensities: Type not specified



Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Type not specified

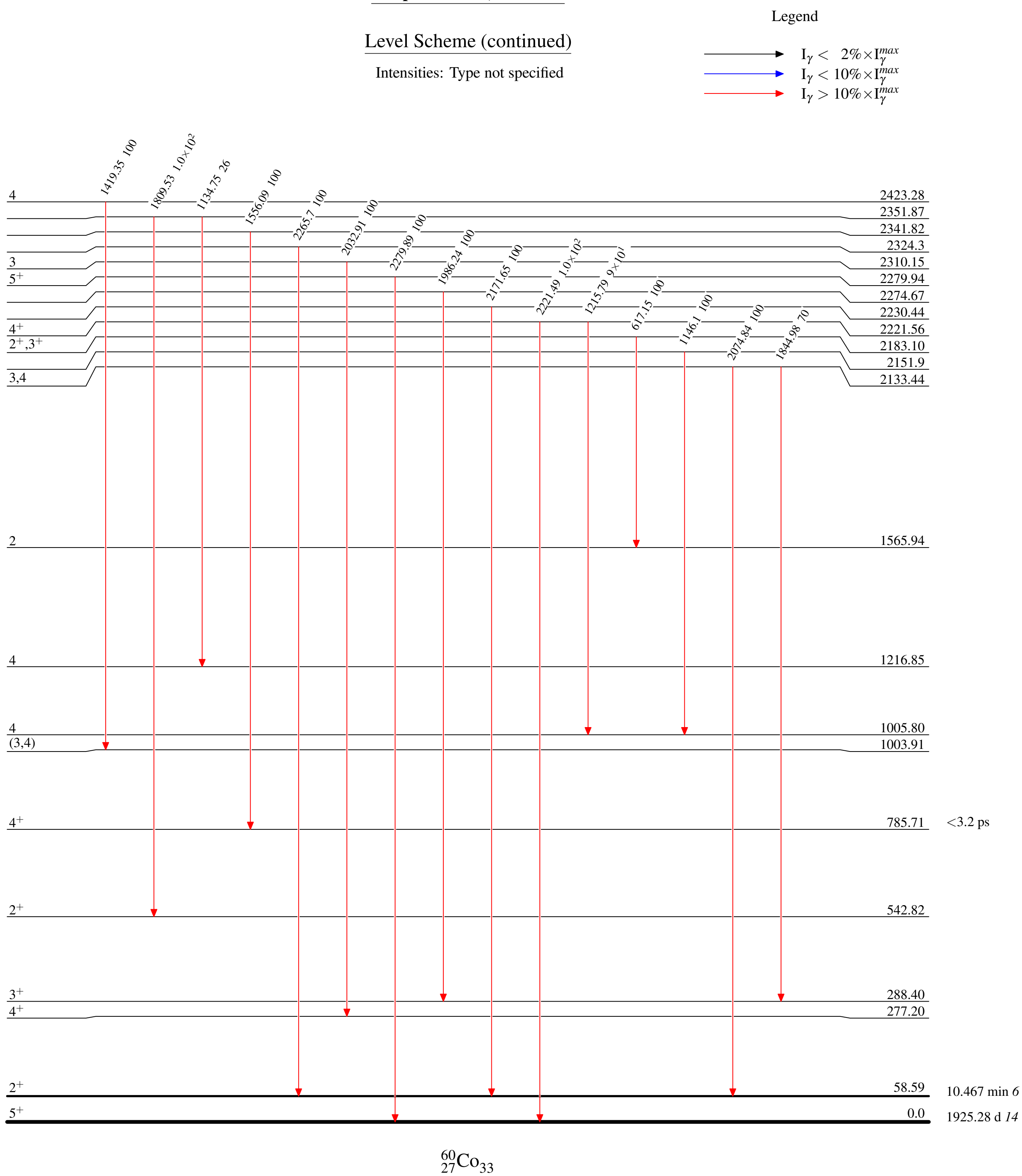


$^{60}_{27}Co_{33}$

Adopted Levels, Gammas

Level Scheme (continued)

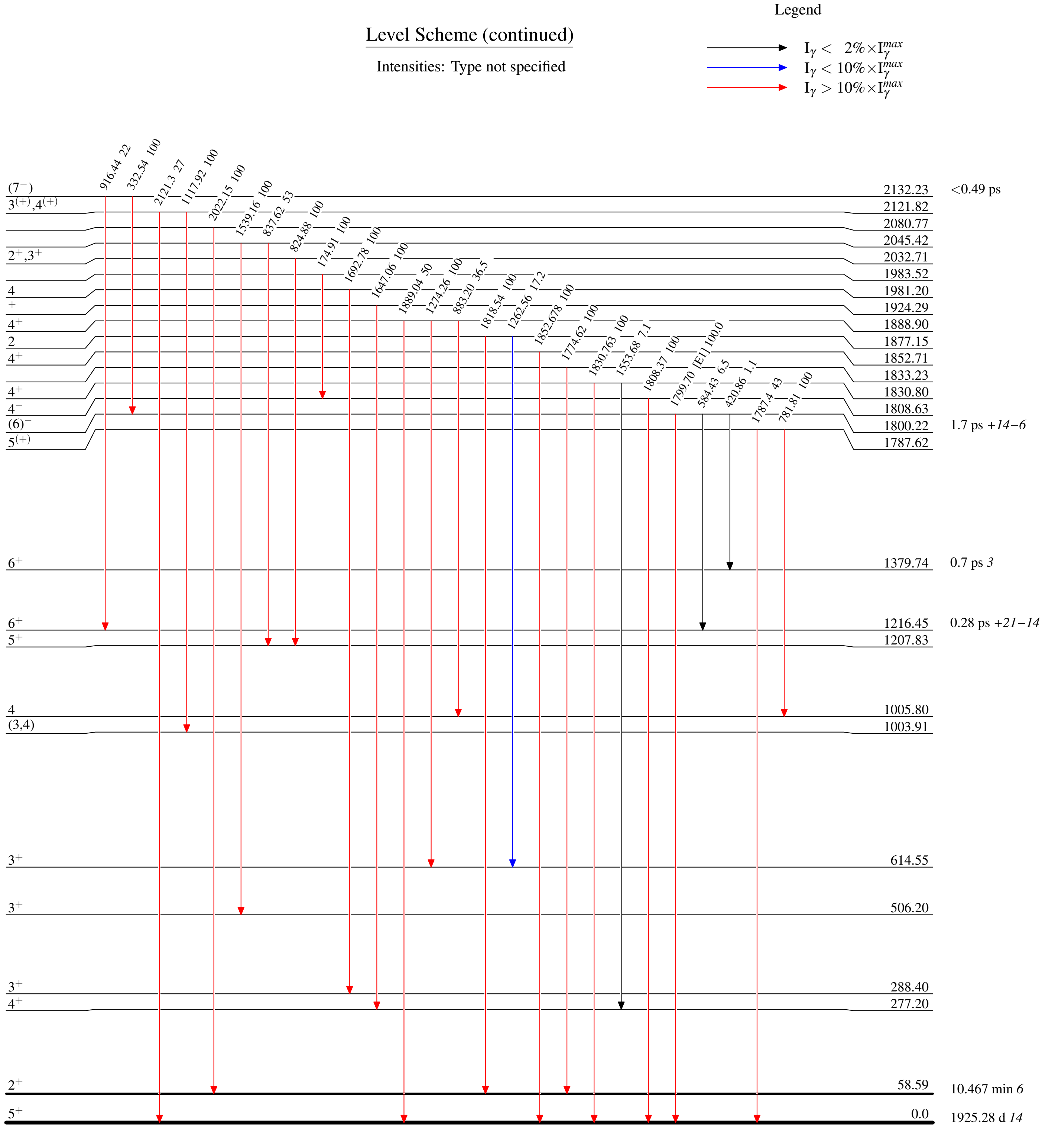
Intensities: Type not specified



Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Type not specified

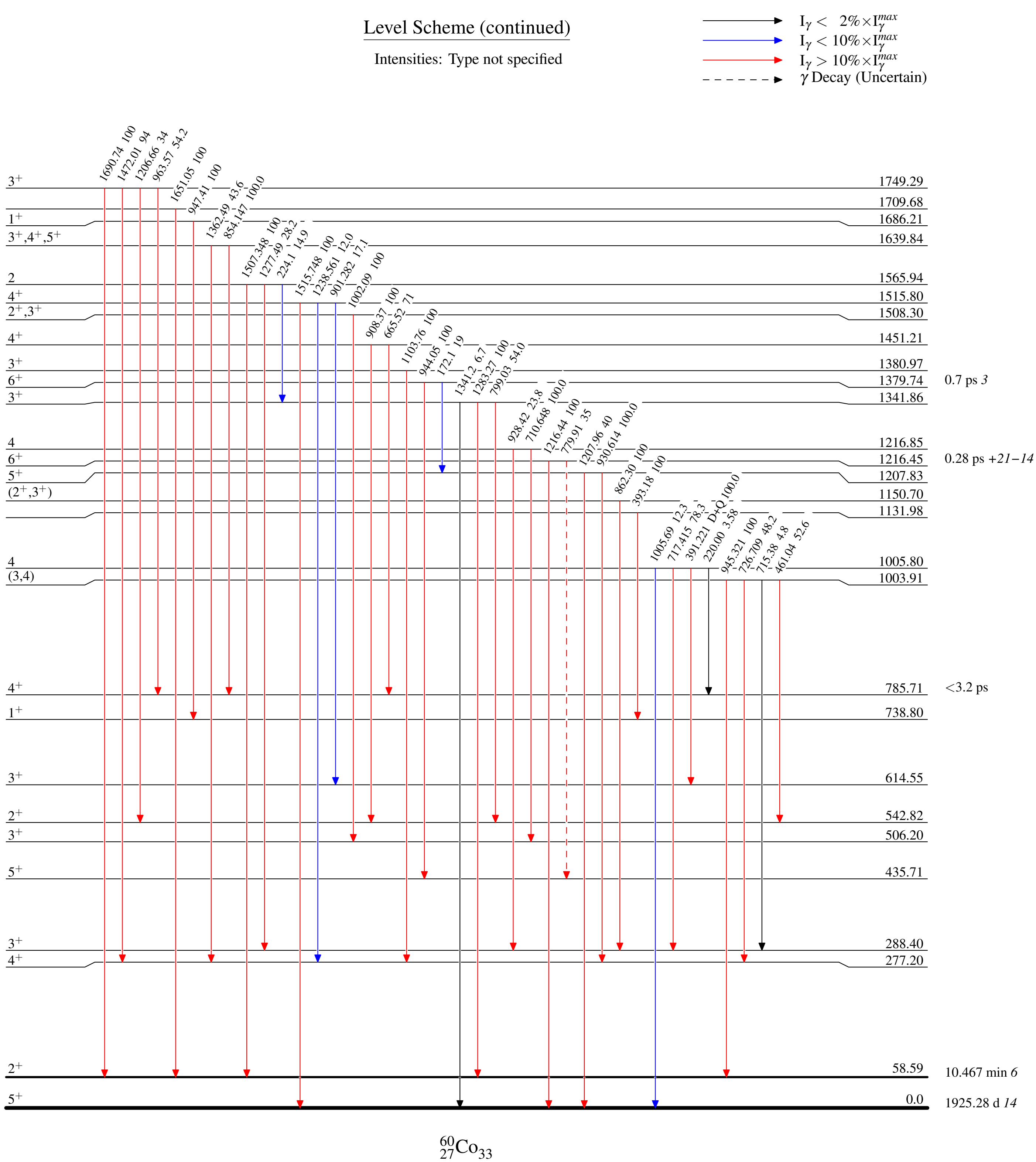


$^{60}_{27}Co_{33}$

Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Type not specified



Adopted Levels, Gammas