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^-)=237 *3*; S(n)=8820 *4*; S(p)=13176 *4*; Q(α)=−8556 *4* 2012Wa38
Additional information 1.
Others:
Nuclear structure.
2012Lo04, 2012Mu09, 2011Ba39, 2011Ut01, 2009Su20, 2007Al45, 2007Mo15, 2005Al47, 2005Ch12, 2005Pu04, 2004Ag02, 2004Mi54, 2004Pa04, 2002Ca48, 1985Bl11.
Nuclear reactions: 2011Su04, 2006Sc16, 2003Kn01.
Effect of strong magnetic field on ^{60}Co ε decay: 2007Li49.
Compilations.
B(E2) values: 2012Go17, 2012Pr08, 2011PrZZ.
Half-lives: 2011Ch65.
Discovery of element iron: 2007Li49.

Arguments for J^π assignments

E(level)	L(t,p)#	$\gamma(\theta)$ in (t,pγ)	$\gamma(\theta)$ in (^{48}Ca,2nγ)	L(α,^{2}He)#	(^{64}Ni,Xγ)	Adopt
0	0				0^+	0^+
824	2	2			2^+	2^+
1974	0					0^+
2115	4	2,4			4^+	4^+
2300	2	2			2^+	a
2356	0					0^+
2673	2	1,2,3				2^+
2756	2					2^+
2793					4^+	4^+
3039	2	1,2,3				2^+
3072	4	2,4		4		4^+
3293	3					3^-
3308		1,2,3,4				
3499	4					(4^+)
3516				4,5	(5^+)	(5^+)
3520			(6^+)		(6^+)	(6^+)
3520			(4^+)		(4^+)	(4^+)
3562	(3)					(3^-)
3582			(6^+)			(6^+)
3635	2					2^+
3698	0					0^+
3867	3					3^-
3904			(6^+)			(6^+)
3929	2					2^+
3932			6^+			6^+
3958			$6^{(-)}$			$6^{(-)}$
3959			(7^+)		(7^+)	(7^+)
4053	3					3^-
4176	2					2^+
4280	3					3^-
4296			$7^{(-)}$			$7^{(-)}$
4358			$7^{(-)}$	7		$7^{(-)}$
4359	5					5^-
4440	3					3^-
4451			6^+			6^+
4503	4					4^+
4650	2					2^+

4755	(3)			(3^-)
4958	4			4^+
5006		$8^{(-)}$		$8^{(-)}$
5029	4			4^+
5103	2			2^+
5218	3			3^-
5310	(5)		5,7	(5^-)
5333		$8^{(+)}$		$8^{(+)}$
5529		$9^{(-)}$		$9^{(-)}$
5550		8^+		8^+
5620	(7)		7,5	(7^-)
5755		9^-		9^-
6475		10^+		10^+
6550		$10^{(-)}$		$10^{(-)}$
6620	(8,6)		8+6	$(8^+,6^+)$
6740		(9,10)		(9,10)
7250		$11^{(-)}$		$11^{(-)}$
7632		$11^{(-)}$		$11^{(-)}$
7890		11		11
8059		12^+		12^+
8536		$12^{(-)}$		$12^{(-)}$
9503		(13^-)		(13^-)
9996		14^+		14^+
10721		(14^-)		(14^-)
11810		15		15
12116		(15^-)		(15^-)
12319		(16^+)		(16^+)
12833		(16^-)		(16^-)
14583		(17^-)		(17^-)
14985		(18^+)		(18^+)
17956		(20^+)		(20^+)

J^π of ^{58}Fe(g.s.) is 0^+.
a $J^\pi=2^+$ not consistent with logft in β- decay.

^{60}Fe Levels

Cross Reference (XREF) Flags

A	^{60}Mn β^- decay (1.77 s)	E	^{58}Fe(t,pγ)	I	^{64}Ni(^{3}He,^{7}Be)
B	^{60}Mn β^- decay (0.28 s)	F	^{64}Ni(d,^{6}Li)	J	^{62}Ni(^{14}C,^{16}O)
C	^{14}C(^{48}Ca,2nγ)	G	^{48}Ca(^{15}N,2npγ),(^{18}O,2n$\alpha\gamma$)	K	^{208}Pb(^{64}Ni,Xγ)
D	^{58}Fe(t,p)	H	^{58}Fe(α,^{2}He)	L	^{64}Ni(^{238}U,X)

E(level)[†]	J^π[‡]	$T_{1/2}$[#]	XREF	Comments
0.0[a]	0^+	2.62×10^6 y *4*	ABCDEFGHIJKL	$\%\beta^-=100$ $T_{1/2}$: From 2009Ru08. Specific activity measurement. Measured activity of ^{60}Fe in the source, its isotopic composition, and the number of iron atoms in the source. $T_{1/2}$: Other values: 1.49×10^6 y *27*, specific activity measurement and radioisotope concentration (1984Ku28). 3×10^5 y (1957Ro54). $T_{1/2}$: a larger sample material and a more accurate determination of the number of atoms suggests the result in 2009Ru08 is the most accurate. $T_{1/2}$: The half-life of ^{60}Fe plays a prominent role in various astrophysical matters.
823.83[a] *9*	2^+	7.9 ps *8*	ABCDEFG IJKL	$T_{1/2}$: From 2010Lj01 in ^{64}Ni(^{238}U,X). Other value: 8.0 ps *15* (1977Wa10).
1974.0 *5*	0^+		B DE	

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{60}Fe Levels (continued)

E(level)[†]	J^{π}[‡]	$T_{1/2}$[#]	XREF	Comments
2114.60[a] *12*	4^+	0.83 ps *21*	A CDEFG I K	
2299.67 *11*			A DE K	$J^{\pi}=2^+$ from 1476γ M1 to 2^+, and 2300γ E2 to 0^+. However, log *ft*=5.0 to 2300-keV level is not consistent with β^- decay from ^{60}Mn(4^+) to ^{60}Fe(2^+).
2356.2 *10*	0^+		B D F	
2672.9[&] *9*	2^+		DE	
2755.9[&] *10*	2^+		DE	
2792.68 *11*	3^+,4^+		A K	J^{π}: $J^{\pi}=3^+$ from (M1) γ rays to $J^{\pi}=2^+$, 4^+ levels in ^{60}Fe. $J^{\pi}=4^+$ from ^{208}Pb(^{64}Ni,Xγ).
3038.9[&] *10*	2^+		DEF	
3072.01 *23*	4^+		A DE HI	
3193.51 *24*			A	
3293 *4*	3^-		D	
3307.9[&] *9*			EF	
3352.9 *6*			A	
3486.02 *24*			A	
3498.6? *10*	(4^+)		A D	
3516.15[b] *18*	(5^-)	49 ps *21*	C GH K	XREF: H(3520). $T_{1/2}$: assignment to 3516 level is uncertain.
3520[@] *50*	(4^+)		H	
3520.12[a] *22*	6^+		C K	
3562 *5*	(3^-)		D	
3582.21 *18*	(6^+)		C K	
3635 *4*	2^+		D F	
3647.9[&] *9*			E	
3698 *5*	0^+		D	
3713.9[&] *10*			E	
3867 *5*	3^-		D	
3874.9[&] *9*			E	
3904.5 *3*	(6^+)		C	
3929.9 *10*	2^+		DE	
3931.87 *18*	6^+		C	
3958.20[c] *18*	$6^{(-)}$	>0.4 ps	C G	
3959.13 *25*	(7^+)		K	
4053 *8*	3^-		D	
4176 *8*	2^+		D	
4280 *8*	3^-		D	
4296.49 *18*	$7^{(-)}$	>0.4 ps	C G	
4298.2 *4*			K	
4358.30[b] *18*	$7^{(-)}$		C H	
4359.5 *3*	5^-		D G K	
4440 *10*	3^-		D	
4451.4 *3*	6^+		C	
4503 *10*	4^+		D	
4650 *10*	2^+		D	
4755 *9*	(3^-)		D	
4958 *9*	4^+		D	
5006.08[c] *19*	$8^{(-)}$	0.8 ps *+13−4*	C G	
5029 *10*	4^+		D	
5103 *10*	2^+		D	
5218 *16*	3^-		D F	
≈5310[@]	(5^-)		H	

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{60}Fe Levels (continued)

E(level)[†]	J^{π}[‡]	XREF	Comments
5333.39[a] *19*	8^+	C	
5434 *17*		D	
5528.75[b] *20*	$9^{(-)}$	C	
5549.6 *5*	8^+	C K	
5596 *18*		D	
≈5620[@]	(7^-)	H	
5754.62 *19*	9^-	C	
6314.7 *5*		C	
6475.27[a] *21*	10^+	C	
6550.10[c] *21*	$10^{(-)}$	C	
6578.62 *22*		C	
≈6620[@]	$(8^+,6^+)$	H	J^{π}: configuration=$(\nu\ g_{9/2})^2 8^+$ or $((\nu\ g_{9/2})(\nu\ d_{5/2}))6^+$.
6740.1[d] *4*	(9,10)	C	
6944.4 *5*		C	
7003.4 *6*		C	
7243.13 *24*		C	
7250.07[b] *23*	$11^{(-)}$	C	
7631.9 *4*	$11^{(-)}$	C	
7664.9 *3*		C	
7890.41[d] *22*	11	C	
8059.49[a] *23*	12^+	C	
8536.5[c] *3*	$12^{(-)}$	C	
8920.2 *5*		C	
8974.4 *7*		C	
9503.2[b] *4*	(13^-)	C	
9559.43[d] *25*	13	C	
9995.83[a] *25*	14^+	C	
10670.4 *13*		C	
10721.0[c] *8*	(14^-)	C	
11810.5[d] *6*	15	C	
12116.2[b] *11*	(15^-)	C	
12319.0[a] *16*	(16^+)	C	
12833.1[c] *17*	(16^-)	C	
14583.4[b] *15*	(17^-)	C	
14984.6[a] *17*	(18^+)	C	
17956[a] *4*	(20^+)	C	

[†] Levels connected by γ's are from least-squares fit to Eγ, others are from (t,p), unless stated otherwise.
[‡] See separate table. See ^{58}Fe(t,p) and ^{58}Fe(α,^{2}He) references for level configurations used in DWBA calculations.
[#] From ^{48}Ca(^{15}N,2npγ),(^{18}O,2n$\alpha\gamma$); recoil distance method for levels below 3.6 MeV and DSA method for levels above this energy, except the g.s.
[@] From ^{58}Fe(α,^{2}He).
[&] From ^{58}Fe(t,pγ) (1977Wa10). Kept fixed in least-squares fit.
[a] Band(A): Yrast band.
[b] Band(B): Band based on $J^{\pi}=5^{(-)}$.
[c] Band(b): Band based on $J^{\pi}=6^{(-)}$.
[d] Band(C): Band based on J^{π}=(9,10).

Adopted Levels, Gammas (continued)

$\gamma(^{60}Fe)$

E_i(level)	J^π_i	E_γ	I_γ[b]	E_f	J^π_f	Mult.	α[†]	Comments
823.83	2+	823.8 *1*	100	0.0	0+	[E2]	0.000319 *5*	B(E2)(W.u.)=13.6 *14* α=0.000319 *5*; α(K)=0.000287 *4*; α(L)=2.75×10^{-5} *4*; α(M)=3.78×10^{-6} *6*; α(N+..)=1.740×10^{-7} *25* α(N)=1.740×10^{-7} *25*
1974.0	0+	1150.2 *4*	100	823.83	2+			
2114.60	4+	1290.8 *1*	100	823.83	2+	[E2]	0.0001356 *19*	B(E2)(W.u.)=14 *4* α=0.0001356 *19*; α(K)=9.84×10^{-5} *14*; α(L)=9.36×10^{-6} *14*; α(M)=1.289×10^{-6} *18*; α(N+..)=2.65×10^{-5} α(N)=5.98×10^{-8} *9*; α(IPF)=2.65×10^{-5} *4*
2299.67		1475.8[&] *1*	80[&] *4*	823.83	2+	(M1)	0.0001331 *19*	α=0.0001331 *19*; α(K)=6.70×10^{-5} *10*; α(L)=6.35×10^{-6} *9*; α(M)=8.74×10^{-7} *13*; α(N+..)=5.89×10^{-5} *9* α(N)=4.08×10^{-8} *6*; α(IPF)=5.88×10^{-5} *9*
		2299.7[&] *2*	100[&] *7*	0.0	0+			Mult.: (E2) from ΔJ^π in 2010Ho13 not consistent with β^- decay.
2356.2	0+	1532.4	100	823.83	2+			
2672.9	2+	1849[@]	100[@]	823.83	2+			
2755.9	2+	1932[@]	100[@]	823.83	2+			
2792.68	3+,4+	493.0[&] *1*	36.2[&] *19*	2299.67		(M1)	0.000697 *10*	α=0.000697 *10*; α(K)=0.000628 *9*; α(L)=6.02×10^{-5} *9*; α(M)=8.29×10^{-6} *12*; α(N+..)=3.84×10^{-7} *6* α(N)=3.84×10^{-7} *6*
		678.1[&] *1*	5.1[&] *6*	2114.60	4+	(M1)	0.000348 *5*	α=0.000348 *5*; α(K)=0.000314 *5*; α(L)=3.00×10^{-5} *5*; α(M)=4.13×10^{-6} *6*; α(N+..)=1.92×10^{-7} *3* α(N)=1.92×10^{-7} *3*
		1968.8[&] *1*	100[&] *5*	823.83	2+	(M1)	0.000285 *4*	α=0.000285 *4*; α(K)=4.00×10^{-5} *6*; α(L)=3.78×10^{-6} *6*; α(M)=5.21×10^{-7} *8*; α(N+..)=0.000241 *4* α(N)=2.43×10^{-8} *4*; α(IPF)=0.000241 *4*
3038.9	2+	2215[@]	100[@]	823.83	2+			
3072.01	4+	279.6[&] *7*	11[&] *7*	2792.68	3+,4+	M1	0.00260 *4*	α=0.00260 *4*; α(K)=0.00234 *4*; α(L)=0.000226 *4*; α(M)=3.11×10^{-5} *5*; α(N+..)=1.431×10^{-6} *22* α(N)=1.431×10^{-6} *22*
		957.5[&] *3*	48[&] *7*	2114.60	4+	M1	0.0001708 *24*	α=0.0001708 *24*; α(K)=0.0001540 *22*; α(L)=1.464×10^{-5} *21*; α(M)=2.02×10^{-6} *3* α(N)=9.39×10^{-8} *14*
		2248.0[&] *3*	100[&] *22*	823.83	2+	E2	0.000471 *7*	α=0.000471 *7*; α(K)=3.35×10^{-5} *5*; α(L)=3.17×10^{-6} *5*; α(M)=4.36×10^{-7} *7*; α(N+..)=0.000434 *6* α(N)=2.03×10^{-8} *3*; α(IPF)=0.000434 *6*
3193.51		401.0[c] *10*	7 *7*	2792.68	3+,4+			
		1078.9 *2*	100 *14*	2114.60	4+			

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

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

E_i(level)	J^π_i	E_γ	I_γ[b]	E_f	J^π_f	Mult.	α[†]	Comments
3307.9		635[@]	100[@] *20*	2672.9	2^+			
		2484[@]	100[@] *20*	823.83	2^+			
3352.9		1238.3[&] *5*	100[&]	2114.60	4^+			
3486.02		1371.4[&] *2*	100[&]	2114.60	4^+			
3498.6?	(4^+)	1384.0[&c] *10*	100[&]	2114.60	4^+	M1	0.0001201 *17*	α=0.0001201 *17*; α(K)=7.55×10^{-5} *11*; α(L)=7.15×10^{-6} *10*; α(M)=9.86×10^{-7} *14*; α(N+..)=3.65×10^{-5} *6* α(N)=4.60×10^{-8} *7*; α(IPF)=3.64×10^{-5} *6*
3516.15	(5^-)	1401.56[#] *19*	100	2114.60	4^+	[E1]	0.000233 *4*	B(E1)(W.u.)=0.32×10^{-5} *14* α=0.000233 *4*; α(K)=4.17×10^{-5} *6*; α(L)=3.95×10^{-6} *6*; α(M)=5.44×10^{-7} *8*; α(N+..)=0.000187 *3* α(N)=2.53×10^{-8} *4*; α(IPF)=0.000187 *3*
3520.12	6^+	1405.4[‡] *3*	100	2114.60	4^+			
3582.21	(6^+)	1467.4[‡] *3*	100	2114.60	4^+			
3647.9		2824[@]	100	823.83	2^+			
3713.9		2890[@]	100	823.83	2^+			
3874.9		227[@]		3647.9				
		3051[@]		823.83	2^+			
3904.5	(6^+)	1789.1[a] *7*	100[a]	2114.60	4^+			
3929.9	2^+	3106	100	823.83	2^+			
3931.87	6^+	349.5[a] *1*	15.6[a] *16*	3582.21	(6^+)			
		1817.4[a] *2*	100[a] *5*	2114.60	4^+			
3958.20	$6^{(-)}$	375.9[a] *1*	27[a] *1*	3582.21	(6^+)			
		437.9[a] *3*	100[a] *3*	3520.12	6^+			
		441.9[a] *1*	47[a] *2*	3516.15	(5^-)			
		1843[a] *5*	1.3[a] *7*	2114.60	4^+			
3959.13	(7^+)	377.0[‡] *3*		3582.21	(6^+)			
		439.0[‡] *3*		3520.12	6^+			
		442.9[‡] *3*		3516.15	(5^-)			
4296.49	$7^{(-)}$	338.2[a] *1*	100[a] *4*	3958.20	$6^{(-)}$			
		364.5[a] *1*	37[a] *1*	3931.87	6^+			
		714.4[a] *1*	53[a] *2*	3582.21	(6^+)			
		780.6[a] *10*	99[a] *4*	3516.15	(5^-)			
4298.2		339.1[‡] *3*	100	3959.13	(7^+)			
4358.30	$7^{(-)}$	399.9[a] *1*	5.7[a] *6*	3958.20	$6^{(-)}$			
		426.4[a] *4*	1.1[a] *6*	3931.87	6^+			
		453.7[a] *2*	2.9[a] *6*	3904.5	(6^+)			
		842.3[a] *1*	100[a] *4*	3516.15	(5^-)			
4359.5	5^-	843.3[#] *2*	100	3516.15	(5^-)			
4451.4	6^+	2336.9[a] *20*	100[a]	2114.60	4^+			
5006.08	$8^{(-)}$	647.7[a] *2*	4.7[a] *6*	4358.30	$7^{(-)}$			
		1047.9[a] *1*	100[a] *3*	3958.20	$6^{(-)}$	[E2]	0.0001749 *25*	B(E2)(W.u.)=40.1 α=0.0001749 *25*; α(K)=0.0001577 *22*; α(L)=1.503×10^{-5} *21*; α(M)=2.07×10^{-6} *3* α(N)=9.57×10^{-8} *14*
5333.39	8^+	882.0[a] *2*	22[a] *1*	4451.4	6^+			
		1036.8[a] *1*	100[a] *3*	4296.49	$7^{(-)}$			

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

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

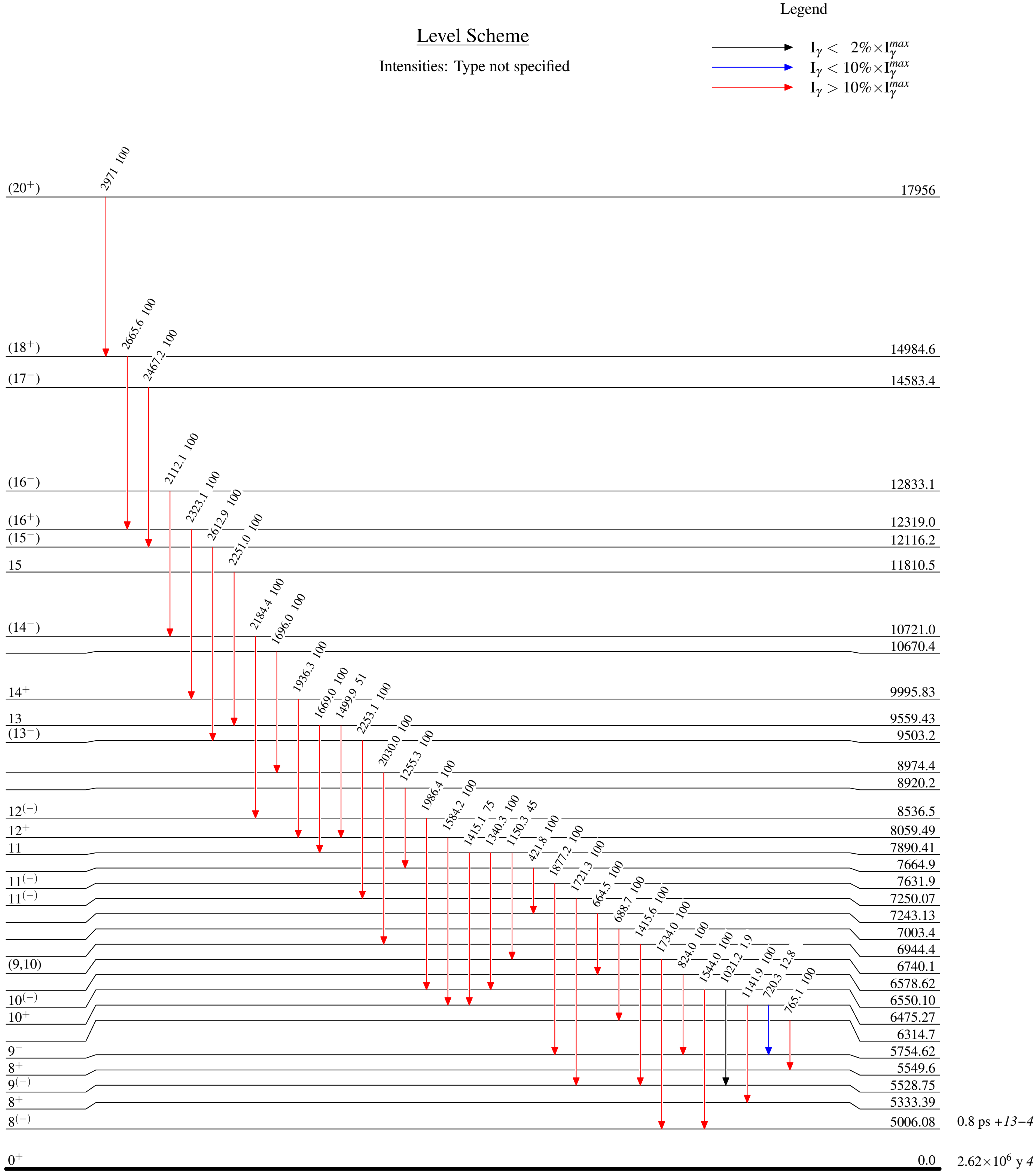
E_i(level)	J^π_i	E_γ	I_γ[b]	E_f	J^π_f
5333.39	8^+	1751.6[a] 2	58[a] 2	3582.21	(6^+)
		1813.4[a] 4	21[a] 1	3520.12	6^+
5528.75	$9^{(-)}$	522.8[a] 2	4.6[a] 7	5006.08	$8^{(-)}$
		1170.4[a] 1	100[a] 3	4358.30	$7^{(-)}$
		1232.3[a] 6	4.6[a] 7	4296.49	$7^{(-)}$
5549.6	8^+	1967.4[a] 4	100[a]	3582.21	(6^+)
5754.62	9^-	748.5[a] 1	18[a] 1	5006.08	$8^{(-)}$
		1458.1[a] 1	100[a] 3	4296.49	$7^{(-)}$
6314.7		765.1[a] 2	100[a]	5549.6	8^+
6475.27	10^+	720.3[a] 3	12.8[a] 6	5754.62	9^-
		1141.9[a] 1	100[a] 3	5333.39	8^+
6550.10	$10^{(-)}$	1021.2[a] 15	1.9[a] 9	5528.75	$9^{(-)}$
		1544.0[a] 1	100[a] 3	5006.08	$8^{(-)}$
6578.62		824.0[a] 1	100[a]	5754.62	9^-
6740.1	(9,10)	1734.0[a] 5	100[a]	5006.08	$8^{(-)}$
6944.4		1415.6[a] 4	100[a]	5528.75	$9^{(-)}$
7003.4		688.7[a] 3	100[a]	6314.7	
7243.13		664.5[a] 1	100[a]	6578.62	
7250.07	$11^{(-)}$	1721.3[a] 1	100[a]	5528.75	$9^{(-)}$
7631.9	$11^{(-)}$	1877.2[a] 3	100[a]	5754.62	9^-
7664.9		421.8[a] 1	100[a]	7243.13	
7890.41	11	1150.3[a] 3	45[a] 5	6740.1	(9,10)
		1340.3[a] 1	100[a] 5	6550.10	$10^{(-)}$
		1415.1[a] 10	75[a] 5	6475.27	10^+
8059.49	12^+	1584.2[a] 1	100[a]	6475.27	10^+
8536.5	$12^{(-)}$	1986.4[a] 2	100[a]	6550.10	$10^{(-)}$
8920.2		1255.3[a] 4	100[a]	7664.9	
8974.4		2030.0[a] 5	100[a]	6944.4	
9503.2	(13^-)	2253.1[a] 3	100[a]	7250.07	$11^{(-)}$
9559.43	13	1499.9[a] 2	51[a] 3	8059.49	12^+
		1669.0[a] 2	100[a] 3	7890.41	11
9995.83	14^+	1936.3[a] 1	100[a]	8059.49	12^+
10670.4		1696.0[a] 11	100[a]	8974.4	
10721.0	(14^-)	2184.4[a] 7	100[a]	8536.5	$12^{(-)}$
11810.5	15	2251.0[a] 5	100[a]	9559.43	13
12116.2	(15^-)	2612.9[a] 10	100[a]	9503.2	(13^-)
12319.0	(16^+)	2323.1[a] 15	100[a]	9995.83	14^+
12833.1	(16^-)	2112.1[a] 15	100[a]	10721.0	(14^-)
14583.4	(17^-)	2467.2[a] 10	100[a]	12116.2	(15^-)
14984.6	(18^+)	2665.6[a] 7	100[a]	12319.0	(16^+)
17956	(20^+)	2971[a] 3	100[a]	14984.6	(18^+)

† Additional information 2.
‡ From (^{64}Ni,Xγ).
# From ^{48}Ca(^{15}N,2npγ).
@ From ^{58}Fe(t,pγ). Energy from level separation, not included in energy fit.
& From ^{60}Mn β-decay (1.77 s).
[a] From ^{14}C(^{48}Ca,2nγ) (2007De56).
[b] Relative photon branching from each level.
[c] Placement of transition in the level scheme is uncertain.

Adopted Levels, Gammas

Level Scheme

Intensities: Type not specified



$^{60}_{26}Fe_{34}$

Adopted Levels, Gammas

Level Scheme (continued)

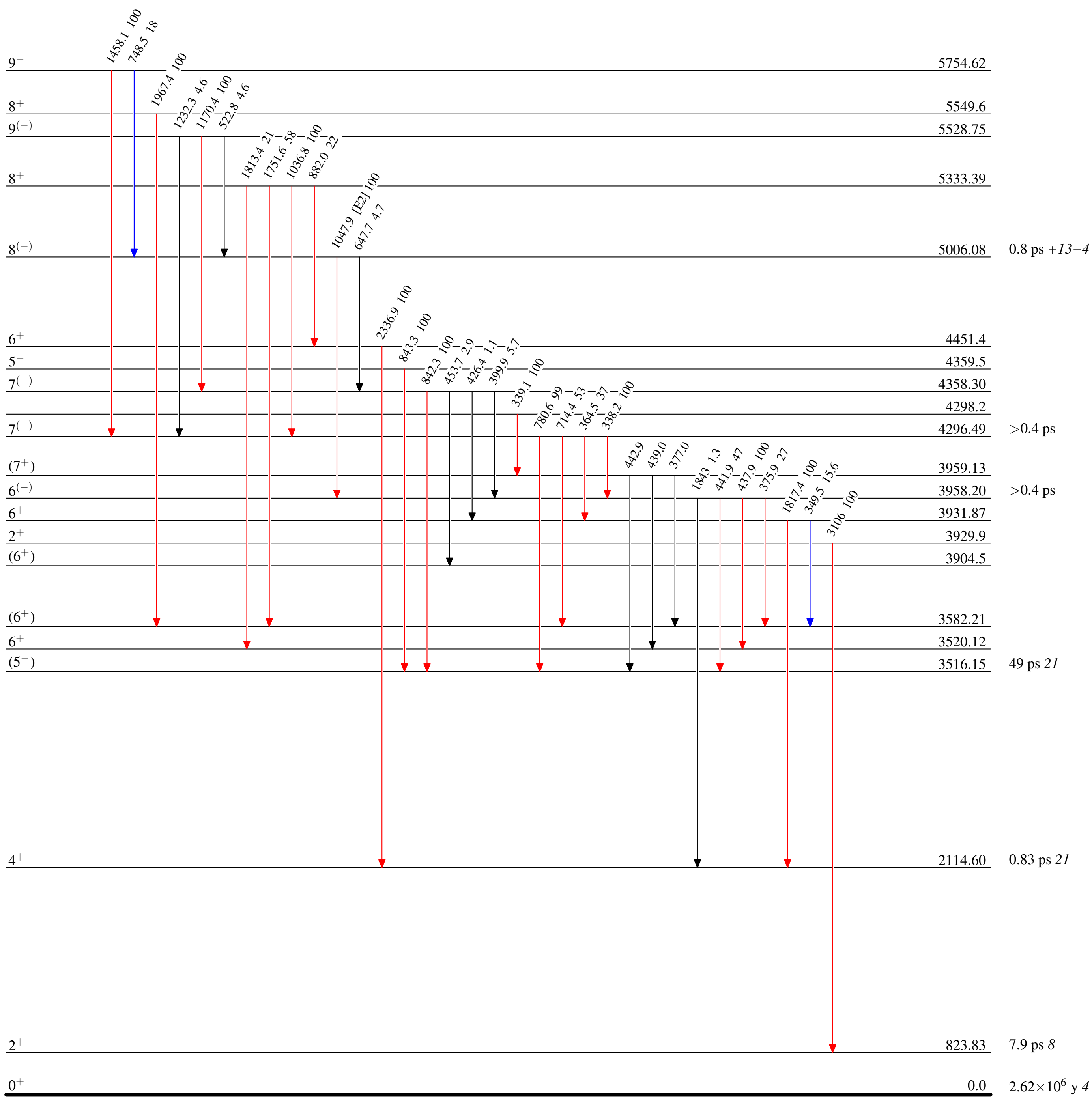
Intensities: Type not specified

Legend

$I_\gamma < 2\% \times I_\gamma^{max}$

$I_\gamma < 10\% \times I_\gamma^{max}$

$I_\gamma > 10\% \times I_\gamma^{max}$

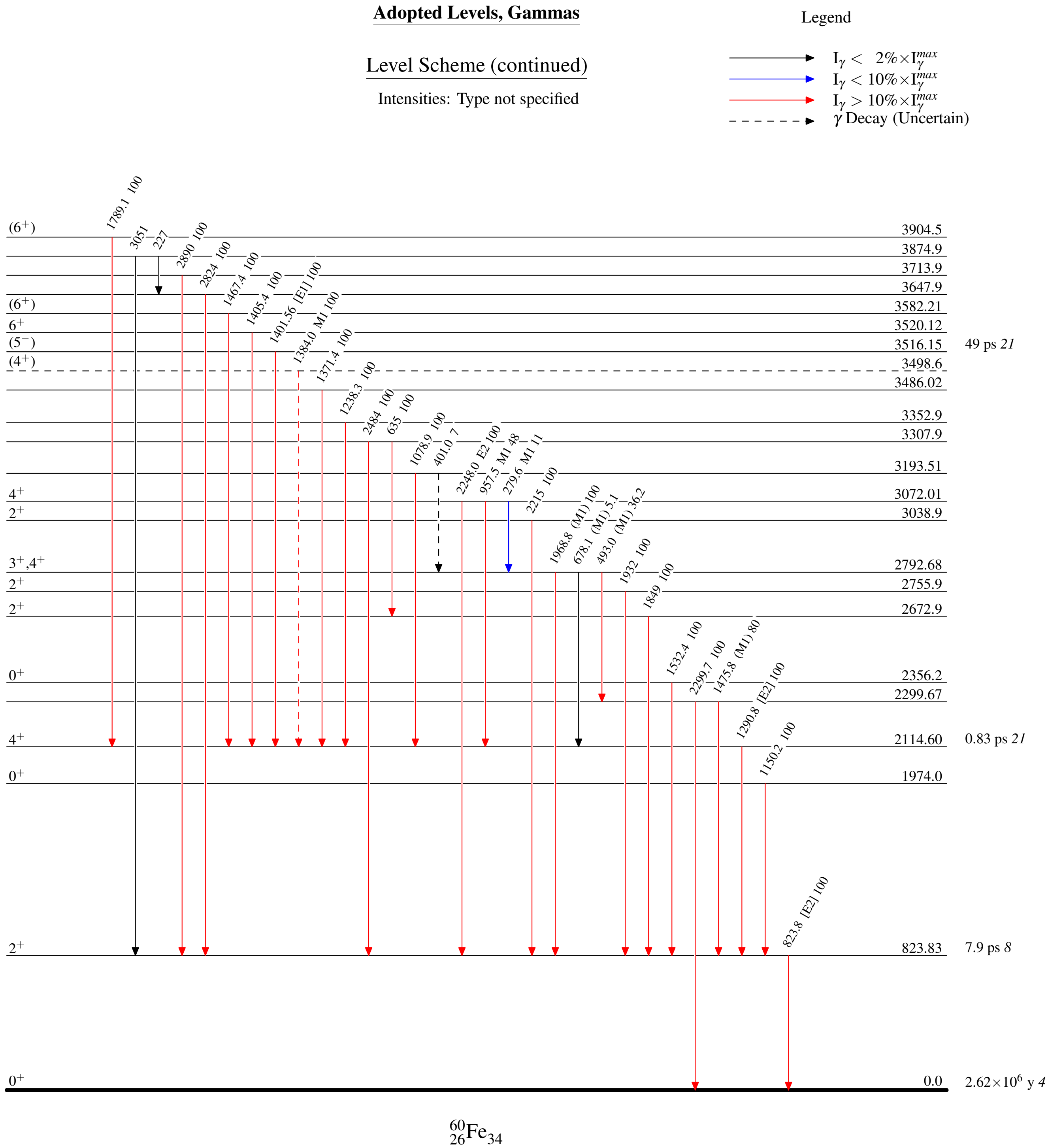


$^{60}_{26}Fe_{34}$

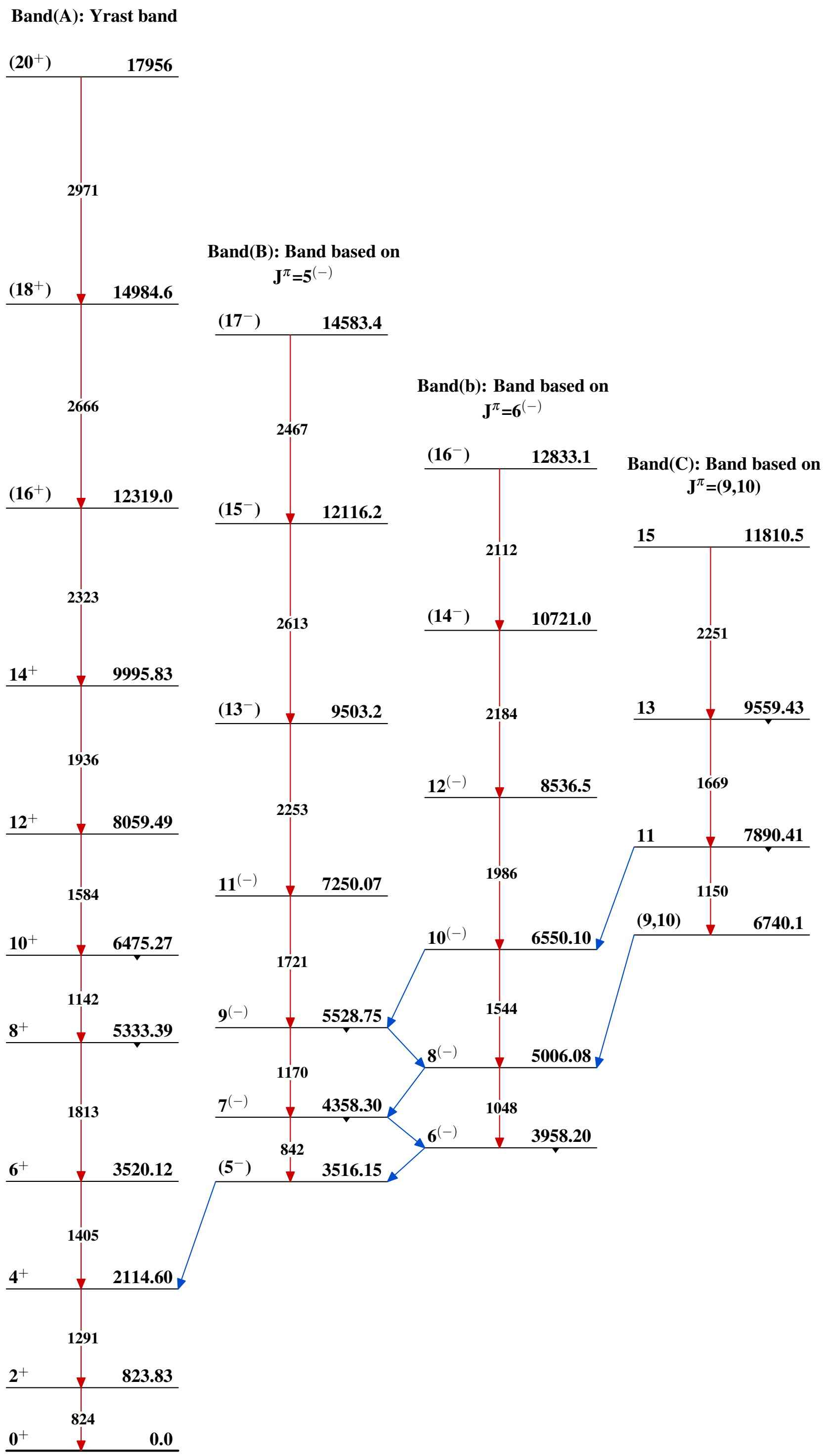
Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Type not specified



Adopted Levels, Gammas



$^{60}_{26}Fe_{34}$