(HI,xnγ) 1994By01,1993De26

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Shaofei Zhu and E. A. Mccutchan	NDS 175, 1 (2021)	1-May-2021

1994By01,1993By01: ^{205}Tl(^{13}C,4nγ), E(^{13}C)=75-84 MeV, ^{208}Pb(^{11}B,5nγ), E(^{11}B)=68-84 MeV; Enriched targets, pulsed beam, Ge detectors, Compton-suppressed, Superconducting solenoidal electron spectrometer, Si(Li) detector; measured Eγ, Iγ, Ice, γγ, Ice(t), γγ(t), γ(θ), γ(θ,H,t). ^{214}Fr deduced levels, J^π, $T_{1/2}$, g-factors.

1993De26: ^{206}Pb(^{11}B,3nγ), E(^{11}B)=64-80 MeV, ^{208}Pb(^{11}B,5nγ), E(^{11}B)=64-80 MeV; pulsed beam, Compton-suppressed Ge detectors, BGO filter array, LN_2 cooled Si(Li) detector; measured Eγ, Iγ, I(ce), γγ, γ(t), γγ(t), γ(θ). ^{214}Fr deduced levels, J^π, $T_{1/2}$.

Others: 1968Va18, 1968To10, 1970To18.

The level scheme is presented as constructed by 1994By01. The proposed decay schemes and spin assignments for levels above the 15^- state deviate drastically from 1993De26. The authors of 1994By01 do not consider the levels above the 15^- state as being well established but appearing more convincing than that of 1993De26. (Priv. Comm. from A. Byrne with Y. A. Akovali (1995El07)).

α: Additional information 1.

^{214}Fr Levels

E(level)[†]	J^π[‡]	$T_{1/2}$	Comments
0.0	(1^-)	5.5 ms *3*	J^π,$T_{1/2}$: from the Adopted Levels.
121 *5*	8^-[#]	3.38 ms *5*	%α=100 E(level),$T_{1/2}$: from the Adopted Levels. J^π: based on shell-model calculations, and being consistent with the 45-keV M1 transition from 9^- (1994By01). Additional information 2.
166 *5*	9^-[#]		
638 *5*	11^+[@]	103 ns *4*	Q=0.8; g=0.511 *6* $T_{1/2}$: deduced from τ= 148 ns *5* (1994By01); other: 174 ns *20* (1993De26). g: TDPAD measurement (1994By01). Q: LEMS measurement (1995Ne06).
937 *5*	11^+		
1080 *5*	12^+		
1367 *5*	$(12)^+$[b]		
1544 *5*	12^+[@]		
1597 *5*	13^-[#]		
1636 *5*			
1661 *5*	14^-[a]	11 ns *2*	g=0.61 *3* $T_{1/2}$: from τ=16 ns *3* (1994By01) and $T_{1/2}$=11 ns *2* (1993De26). g: TDPAD measurement; value is combined with *g*(1732,15^-) (1994By01).
1732 *5*	15^-[#]	10 ns *2*	g=0.61 *3* $T_{1/2}$: from τ= 15 ns *3* (1994By01). g: TDPAD measurement; combined value with *g*(1662,14^-) (1994By01).
1850 *5*	16^-[&]		
2163 *5*	17^+[@]	≤0.7 ns	$T_{1/2}$: from τ ≤ 1 ns (1994By01).
2163+x	19^+[@]		E(level),J^π: Proposed based on the comparision of levels above this level and results from shell-model calculations (1994By01). This level was not proposed to exist, and levels above it in 1993De26 deviate from those in 1994By01. Additional information 3.
2777.6+x *3*			
2808.82+x *16*	20^-[&]		
2901.48+x *18*	20^-		
3054.50+x *16*	21^+[@]		
3087.07+x *25*			

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(HI,xnγ) 1994By01,1993De26 (continued)

^{214}Fr Levels (continued)

E(level)[†]	Jπ[‡]	$T_{1/2}$	Comments
3211.62+x *20*	21^-		
3263.28+x *23*	23^+ [@]	4.2 ns *7*	$T_{1/2}$: from τ=6 ns *1* (1994By01).
3328.6+x *3*	22		
3338.0+x *3*	24^+		
3462.2+x *4*			
3518.42+x *24*	$(22)^-$		
3563.8+x *3*	24^+ [c]		
3838.8+x *4*	24		
3895.4+x *4*	25^+ [c]		
4010.1+x *4*			
4196.0+x *4*	25^-		
4229.2+x *3*	25^- [d]		
4316.5+x *3*	27^- [d]	8.0 ns *2*	g=0.73 *3* $T_{1/2}$: from τ=11.5 ns *2* (1994By01). g: TDPAD measurement (1994By01).
4575.3+x *4*	26^+		
4704.0+x *5*			E(level): 853γ from E(level)=5559+x, but no decay-out transition observed (1994By01).
4925.4+x *4*	28^-		Proposed configuration=$((\pi\ h_{9/2})^{+3}(\pi\ i_{13/2})(\pi\ f_{7/2})(\nu\ j_{15/2}))$ or $(\pi\ h_{9/2})^3(\pi\ i_{13/2})^2(\nu\ i_{13/2})$ (1994By01).
4975.3+x *4*	$(26^+,27^+)$		
5000.3+x *5*			
5205.0+x *4*	(28^+)		Tentatively proposed configuration=$((\pi\ h_{9/2})^{+4}(\pi\ i_{13/2})\ (\nu\ g_{9/2})(\nu\ i_{13/2})(\nu\ p_{1/2})^{-1})$ (1994By01).
5331.4+x *5*	28^+		
5435.4+x *5*			
5557.2+x *4*			
5627.4+x *6*			
5638.7+x *4*	28^+		
5769.2+x *4*	29^-		
6089.7+x *4*	30^-		
6179.0+x *4*	30^-		
6360.6+x *5*	30^-		
6475.3+x *5*	31^-		
6475+y	33^+	108 ns *7*	Q=2.2 *5*; g=0.68 *1* $T_{1/2}$: from τ=156 ns *10* (1994By01). E(level): proposed on the basis of the timing behaviors of γ rays decaying from the 6477+x level, however it is not certain (1994By01). g: TDPAD measurement (1994By01). Q: LEMS measurement (1995Ne06). Proposed configuration= $((\pi\ h_{9/2})^{+3}(\pi\ i_{13/2})(\nu\ g_{9/2})(\nu\ i_{11/2})\ (\nu\ p_{1/2})^{-1})$ (1994By01). Additional information 4.
6521.4+x *5*			
6812.0+y *3*	(34^+)		
6915.9+x *6*			
7256.0+y *4*			
7543.0+y *3*	36^-	4.9 ns *14*	$T_{1/2}$: from τ=7 ns *2* (1994By01). Proposed configuration= $((\pi\ h_{9/2})^{+3}(\pi\ i_{13/2})^{+2}(\nu\ i_{11/2})(\nu\ j_{15/2})\ (\nu\ p_{1/2})^{-1})$ (1994By01).
7547.0+y *5*	(35^+)		
7846.1+y *5*			Proposed configuration= $((\pi\ h_{9/2})^{+3}(\pi\ i_{13/2})^{+2}(\nu\ g_{9/2})^{+2}(\nu\ i_{11/2})\ (\nu\ p_{1/2})^{-2})$, with $J^\pi=36^-$ (1994By01).
8142.0+y *5*			

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(HI,xnγ) 1994By01,1993De26 (continued)

^{214}Fr Levels (continued)

E(level)[†]	Comments
8656.3+y *6*	Proposed configuration= $((\pi\ h_{9/2})^{+3}(\pi\ i_{13/2})^{+2}(\nu\ g_{9/2})(\nu\ i_{11/2})^{+2}\ (\nu\ p_{1/2})^{-2})$, with $J^{\pi}=37^{-}$ (1994By01).

† From a least squares fit to Eγ's by evaluators, unless otherwise noted.
‡ As proposed by 1994By01 based on γ multipolarities and on comparison with shell-model calculations.
# Configuration=$((\pi\ h_{9/2})^{+5}(\nu\ g_{9/2}))$.
@ Configuration=$((\pi\ h_{9/2})^{+4}(\pi\ i_{13/2})(\nu\ g_{9/2}))$.
& Configuration=$((\pi\ h_{9/2})^{+4}(\pi\ f_{7/2})(\nu\ g_{9/2}))$.
a Configuration=$((\pi\ h_{9/2})^{+4}(\pi\ i_{13/2})(\nu\ j_{15/2}))$.
b Configuration=$((\pi\ h_{9/2})^{+5}(\nu\ j_{15/2}))$.
c Configuration=$((\pi\ h_{9/2})^{+3}(\pi\ i_{13/2})(\pi\ f_{7/2})(\nu\ g_{9/2}))$.
d Configuration=$((\pi\ h_{9/2})^{+3}(\pi\ i_{13/2})^{+2}(\nu\ g_{9/2}))$.

$\gamma(^{214}Fr)$

E_γ [†]	I_γ [‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult.	δ	α	Comments
44.7 *2*	40 *10*	166	9^-	121	8^-	M1+E2	0.09 *10*	33 *10*	α(L)=25 *8*; α(M)=6.0 *21*; α(N)=1.6 *5*; α(O)=0.35 *11*; α(P)=0.055 *14*; α(Q)=0.00281 *8* Mult.,δ: from α(tot)exp=33 *10* (1994By01).
45.3[#] *3*		3563.8+x	24^+	3518.42+x	$(22)^-$	[M2]		1.49×10^3 *5*	α(L)=1.09×10^3 *4*; α(M)=303 *10*; α(N)=81.7 *28*; α(O)=17.9 *6*; α(P)=2.69 *9*; α(Q)=0.121 *4* E_γ: from level scheme. Existence of this γ was inferred from $\gamma\gamma$-coincidence data (1994By01). Intensity balance at the 3566+x level, when side feeding is neglected, yields Iγ=0.061 *25* (1994By01).
52.5 *2*	7.4 *3*	1597	13^-	1544	12^+	E1		0.598 *10*	α(L)=0.453 *8*; α(M)=0.1103 *19*; α(N)=0.0283 *5*; α(O)=0.00586 *10*; α(P)=0.000777 *13* α(Q)=2.30×10^{-5} *4* E_γ: other: 53.2 *2* (1993De26). Mult.: from α(tot)exp=9 *4* (1994By01). I_γ: other: 0.7 *2* (1993De26).
63.9 *2*	16 *5*	1661	14^-	1597	13^-	M1		10.38 *17*	α(L)=7.88 *13*; α(M)=1.879 *31*; α(N)=0.493 *8*; α(O)=0.1101 *18*; α(P)=0.01767 *30* α(Q)=0.000989 *17* E_γ: other: 64.2 *2* (1993De26). Mult.: from α(tot)exp=3 *4* (1994By01). I_γ: 0.9 *2* (1993De26).
71.4 *2*	142 *20*	1732	15^-	1661	14^-	M1		7.50 *12*	α(L)=5.70 *9*; α(M)=1.358 *22*; α(N)=0.356 *6*; α(O)=0.0796 *13*; α(P)=0.01278 *21* α(Q)=0.000715 *12* E_γ: other: 71.5 *2* (1993De26). Mult.: from α(tot)exp=7 *1* (1994By01). I_γ: other: 8 *2* (1993De26).
74.5 *3*	21 *7*	3338.0+x	24^+	3263.28+x	23^+	M1		6.63 *12*	α(L)=5.03 *9*; α(M)=1.200 *22*; α(N)=0.315 *6*; α(O)=0.0703 *13*; α(P)=0.01129 *21* α(Q)=0.000631 *12* Mult.: from α(tot)exp=2.4 *15* (1994By01).
87.3 *3*	17 *11*	4316.5+x	27^-	4229.2+x	25^-	E2		16.6 *4*	α(L)=12.22 *26*; α(M)=3.31 *7*; α(N)=0.868 *19*; α(O)=0.180 *4*; α(P)=0.0231 *5*; α(Q)=5.06×10^{-5} *9* Mult.: from α(tot)exp=17 *11* (1994By01).
89.3 *3*	2.8 *4*	6179.0+x	30^-	6089.7+x	30^-	M1		3.91 *7*	α(L)=2.97 *5*; α(M)=0.708 *12*; α(N)=0.1857 *32*; α(O)=0.0415 *7*; α(P)=0.00666 *11* α(Q)=0.000372 *6* Mult.: from α(tot)exp=6 *6* (1994By01).
114.7 *5*	1.5 *5*	6475.3+x	31^-	6360.6+x	30^-	M1+E2	13 *12*	5.0 *23*	α(K)=0 *4*; α(L)=3.4 *10*; α(M)=0.92 *29*; α(N)=0.24 *8*; α(O)=0.050 *15*; α(P)=0.0065 *16* α(Q)=2.E−5 *8* Mult.,δ: from α(tot)exp=5 *2* (1994By01).
118.5 *1*	85 *5*	1850	16^-	1732	15^-	M1		8.84 *13*	α(K)=7.11 *10*; α(L)=1.312 *19*; α(M)=0.313 *4*; α(N)=0.0820 *12*;

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(HI,xnγ) 1994By01,1993De26 (continued)

γ(^{214}Fr) (continued)

E_γ †	I_γ ‡	E_i(level)	J_i^π	E_f	J_f^π	Mult.	α	Comments
								α(O)=0.01833 *26* α(P)=0.00294 *4*; α(Q)=0.0001642 *23* E_γ: other: 118.7 *2* (1993De26). Mult.: from α(tot)exp=9 *1*; A_2=−0.06 15 (1994By01). Proposed sequence of 312.5γ and 118.5γ by 1994By01, reversed from 118.5γ and 312.5γ proposed by 1993De26 on the basis of shell-model calculations (Priv. Comm. from A. Byrne with Y. A. Akovali (1995El07)). I_γ: other: 6.0 *4* (1993De26).
120.3 *3*	7 *2*	4316.5+x	27$^-$	4196.0+x	25$^-$	E2	4.06 *7*	α(K)=0.335 *5*; α(L)=2.74 *5*; α(M)=0.742 *13*; α(N)=0.1947 *35*; α(O)=0.0404 *7* α(P)=0.00523 *9*; α(Q)=1.760×10^{-5} *28* Mult.: from α(tot)exp=4 *2* (1994By01).
124.5 *3*	7 *2*	3211.62+x	21$^-$	3087.07+x				A_2=−0.06 *64* (1994By01).
130.2 *3*	15 *2*	5769.2+x	29$^-$	5638.7+x	28$^+$	E1	0.249 *4*	α(K)=0.1961 *30*; α(L)=0.0405 *6*; α(M)=0.00971 *15*; α(N)=0.00251 *4*; α(O)=0.000540 *8* α(P)=7.85×10^{-5} *12*; α(Q)=3.06×10^{-6} *5* Mult.: from α(tot)exp=0.1 *3*; A_2=−0.32 *26* (1994By01).
135.1 *2*	58 *8*	1732	15$^-$	1597	13$^-$	E2	2.50 *4*	α(K)=0.310 *4*; α(L)=1.615 *25*; α(M)=0.437 *7*; α(N)=0.1146 *18*; α(O)=0.0238 *4* α(P)=0.00310 *5*; α(Q)=1.253×10^{-5} *18* Mult.: from α(tot)exp=1 *1*; A_2=+0.49 *23* (1994By01). I_γ: other: 3.4 *7* (1993De26).
143.3 *2*	44 *3*	1080	12$^+$	937	11$^+$	M1	5.15 *7*	α(K)=4.14 *6*; α(L)=0.761 *11*; α(M)=0.1813 *26*; α(N)=0.0475 *7*; α(O)=0.01062 *15* α(P)=0.001704 *25*; α(Q)=9.51×10^{-5} *14* Mult.: from α(tot)exp=7 *2*; A_2=−0.37 *27* (1994By01). I_γ: other: 1.7 *3* (1993De26).
x159.0	≤22							
x168.8	5 *1*							
177.5 *4*	4 *1*	1544	12$^+$	1367	(12)$^+$	M1	2.81 *4*	α(K)=2.262 *35*; α(L)=0.414 *6*; α(M)=0.0986 *15*; α(N)=0.0258 *4*; α(O)=0.00578 *9* α(P)=0.000927 *14*; α(Q)=5.17×10^{-5} *8* Mult.: from α(tot)exp=5 *2* (1994By01).
185.5 *3*	11 *3*	3087.07+x		2901.48+x	20$^-$			A_2=+0.02 *31* (1994By01).
x197.7 *3*	7 *3*							
208.8 *2*	460 *10*	3263.28+x	23$^+$	3054.50+x	21$^+$	E2	0.474 *7*	α(K)=0.1497 *21*; α(L)=0.2395 *35*; α(M)=0.0642 *9*; α(N)=0.01684 *25*; α(O)=0.00352 *5* α(P)=0.000468 *7*; α(Q)=3.99×10^{-6} *6* Mult.: from α(tot)exp=0.5 *2*; A_2=+0.37 *4* (1994By01).
211.9 *2*	17 *3*	5769.2+x	29$^-$	5557.2+x				A_2=+0.35 *44* (1994By01).
x228.0[a]	3.0 *5*							
245.7 *2*	55[@] *3*	3054.50+x	21$^+$	2808.82+x	20$^-$	E1	0.0542 *8*	α(K)=0.0436 *6*; α(L)=0.00806 *11*; α(M)=0.001917 *27*; α(N)=0.000498 *7* α(O)=0.0001086 *15*; α(P)=1.644×10^{-5} *23*; α(Q)=7.40×10^{-7} *10* Mult.: from α(tot)exp=0.3 *1* with some signal contaminated; A_2=+0.09 *8* (1994By01).
250.6 *3*	8 *2*	3462.2+x		3211.62+x	21$^-$			A_2=−0.18 *26* (1994By01).

$^{214}_{87}Fr_{127}$-5

(HI,xnγ) 1994By01,1993De26 (continued)

γ(^{214}Fr) (continued)

E_γ [†]	I_γ [‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult.	δ	α	Comments
									Another possible placement from energy fit only could be between the 3340+x and 3089+x levels.
[x]254.3 *3*	8 *3*								
274.1 *2*	21 *3*	3328.6+x	22	3054.50+x	21^+	(D)			Mult.: from A_2=−0.15 *19* (1994By01).
279.0 *5*	2 *1*	5205.0+x	(28^+)	4925.4+x	28^-				
296.3 *2*	30 *5*	6475.3+x	31^-	6179.0+x	30^-	M1(+E2)	0.5 *5*	0.57 *16*	α(K)=0.45 *14*; α(L)=0.090 *12*; α(M)=0.0218 *24*; α(N)=0.0057 *6*; α(O)=0.00127 *16* α(P)=0.000200 *31*; α(Q)=1.02×10^{-5} *32* Mult.: from α(tot)exp=0.75 *25*; α(K)exp=0.26 *15* (with some contamination from ^{215}Fr); α(L)exp=0.12 *2*; A_2=−0.58 *11* (1994By01).
[x]299.2 *3*	11 *5*								
299.3 *2*	192 *10*	937	11^+	638	11^+	M1+E2	0.2 *6*	0.64 *18*	α(K)=0.51 *16*; α(L)=0.094 *14*; α(M)=0.0225 *28*; α(N)=0.0059 *7*; α(O)=0.00132 *18* α(P)=0.00021 *4*; α(Q)=1.2×10^{-5} *4* E_γ: other: 299.2 *2* (1993De26). Mult.,δ: from α(K)exp=0.50 *10*; α(L)exp(299.2γ+299.3γ)=0.12 *1*; A_2=0.00 *7* (1994By01); α(K)exp=0.45 *18*; α(L)exp=0.16 *6*; α(M)exp=0.048 *20* (1993De26). I_γ: other: 13 *2* (1993De26).
300.6 *2*	329 *20*	3563.8+x	24^+	3263.28+x	23^+	M1		0.647 *9*	α(K)=0.523 *7*; α(L)=0.0947 *13*; α(M)=0.02254 *32*; α(N)=0.00591 *8*; α(O)=0.001321 *19* α(P)=0.0002119 *30*; α(Q)=1.183×10^{-5} *17* Mult.: from α(K)exp=0.74 *23*. α(L)exp(299.2γ+300.6γ)=0.12 *1*; A_2=−0.70 *5* (1994By01).
303.1 *3*	10 *6*	7846.1+y		7543.0+y	36^-				
306.8 *2*	52 *5*	3518.42+x	$(22)^-$	3211.62+x	21^-	M1+E2	0.8 *+3−8*	0.43 *19*	α(K)=0.33 *17*; α(L)=0.074 *15*; α(M)=0.0182 *31*; α(N)=0.0048 *8*; α(O)=0.00105 *20* α(P)=0.00016 *4*; α(Q)=7.E−6 *4* Mult.: from α(K)exp=0.34 *6*, α(L)exp=0.11 *2*; A_2=−0.05 *11* (1994By01).
310.2 *2*	30 *5*	3211.62+x	21^-	2901.48+x	20^-	M1		0.594 *8*	α(K)=0.479 *7*; α(L)=0.0868 *12*; α(M)=0.02066 *29*; α(N)=0.00542 *8*; α(O)=0.001211 *17* α(P)=0.0001943 *27*; α(Q)=1.084×10^{-5} *15* Mult.: from α(K)exp=0.36 *12*; A_2=+0.80 *26* (1994By01).
312.5 *1*	1066 *20*	2163	17^+	1850	16^-	E1		0.0312 *4*	α(K)=0.02524 *35*; α(L)=0.00453 *6*; α(M)=0.001074 *15*; α(N)=0.000279 *4*; α(O)=6.12×10^{-5} *9* α(P)=9.37×10^{-6} *13*; α(Q)=4.41×10^{-7} *6* E_γ: other: 312.7 *2* (1993De26). Mult.: from α(K)exp=0.026 *2*; α(L)exp=0.011 *7*; A_2=−0.17 *2* (1994By01); α(K)exp=0.032 *13* (1993De26). I_γ: other: 100 *5* (1993De26). The total transition intensity of the 312.5γ is greater than that of

$^{214}_{87}Fr_{127}$-6

(HI,xnγ) **1994By01,1993De26 (continued)**

$\gamma(^{214}Fr)$ (continued)

E_γ †	I_γ ‡	E_i(level)	J_i^π	E_f	J_f^π	Mult.	δ	α	Comments
									118.5γ which is placed cascading below the 312.5γ. If the placements of these γ′s are correct, the intensity balance at the 1851-keV level suggests that the measured Iγ(312.5γ) possibly includes some impurity.
320.5 *3*	18 *3*	6089.7+x	30^-	5769.2+x	29^-	M1		0.543 *8*	α(K)=0.438 *6*; α(L)=0.0794 *11*; α(M)=0.01888 *27*; α(N)=0.00495 *7*; α(O)=0.001106 *16* α(P)=0.0001775 *25*; α(Q)=9.91×10^{-6} *14* Mult.: from α(K)exp=0.69 *18*; A_2=−0.23 *27* (1994By01).
331.7 *2*	47 *5*	3895.4+x	25^+	3563.8+x	24^+	M1		0.494 *7*	α(K)=0.399 *6*; α(L)=0.0722 *10*; α(M)=0.01717 *24*; α(N)=0.00450 *6*; α(O)=0.001006 *14* α(P)=0.0001615 *23*; α(Q)=9.02×10^{-6} *13* Mult.: from α(K)exp=0.56 *8*, α(L)exp=0.10 *3*; A_2=−0.24 *5* (1994By01).
337.0 *3*	9 *1*	6812.0+y	(34^+)	6475+y	33^+	M1		0.473 *7*	α(K)=0.382 *5*; α(L)=0.0691 *10*; α(M)=0.01644 *23*; α(N)=0.00431 *6*; α(O)=0.000964 *14* α(P)=0.0001546 *22*; α(Q)=8.63×10^{-6} *12* Mult.: from α(K)exp=0.39 *9*; α(L)exp=0.15 *4*; A_2=−0.52 *40* (1994By01).
352.0 *3*	3 *1*	5557.2+x		5205.0+x	(28^+)	(D)			A_2=−1.30 *43* (1994By01).
x371.3 *3*	4 *2*								
x382.8 *3*	11 *3*								Eγ: other: 382.4 2 (1993De26). Iγ: other: 12 2 (1993De26).
x387.8 *3*	7 *3*								
394.5 *3*	5 *3*	6915.9+x		6521.4+x					A_2=+0.05 *74* (1994By01).
400.0 *3*	20 *3*	4975.3+x	$(26^+,27^+)$	4575.3+x	26^+	(M1)		0.297 *4*	α(K)=0.2402 *34*; α(L)=0.0433 *6*; α(M)=0.01028 *15*; α(N)=0.00270 *4*; α(O)=0.000603 *9* α(P)=9.67×10^{-5} *14*; α(Q)=5.40×10^{-6} *8* Mult.: from α(K)exp(400.0γ+402.7γ)=0.26 *5*, α(L)exp(400.0γ+402.7γ)=0.10 *2*; A_2=+0.50 *17* (1994By01).
402.7 *3*	15 *3*	3211.62+x	21^-	2808.82+x	20^-	(M1)		0.292 *4*	α(K)=0.2359 *33*; α(L)=0.0425 *6*; α(M)=0.01010 *14*; α(N)=0.00265 *4*; α(O)=0.000592 *8* α(P)=9.50×10^{-5} *13*; α(Q)=5.30×10^{-6} *8* Mult.: from α(K)exp(400γ+402γ)=0.26 *5*; α(L)exp(400γ+402γ)=0.10 *2*; A_2=−0.35 *20* (1994By01).
x405.0 *5*	12 *3*								
409.8 *2*	50 *5*	6179.0+x	30^-	5769.2+x	29^-	M1+E2	1.0 *3*	0.17 *4*	α(K)=0.131 *32*; α(L)=0.029 *4*; α(M)=0.0071 *9*; α(N)=0.00187 *23*; α(O)=0.00041 *5* α(P)=6.4×10^{-5} *9*; α(Q)=3.0×10^{-6} *7* Mult.: from α(K)exp=0.14 *3*; A_2=−0.08 *8* (1994By01).
431.3 *3*	10 *3*	3518.42+x	$(22)^-$	3087.07+x					A_2=−0.04 *20* (1994By01).
442.7 *2*	92 *6*	1080	12^+	638	11^+	M1		0.2261 *32*	α(K)=0.1828 *26*; α(L)=0.0328 *5*; α(M)=0.00780 *11*; α(N)=0.002046 *29*; α(O)=0.000457 *6*

$^{214}_{87}Fr_{127}$-7

(HI,xnγ) 1994By01,1993De26 (continued)

γ(^{214}Fr) (continued)

E_γ †	I_γ ‡	E_i(level)	J_i^π	E_f	J_f^π	Mult.	α	Comments
								α(P)=7.34×10^{-5} *10*; α(Q)=4.10×10^{-6} *6* E_γ: other: 442.8 *2* (1993De26). Mult.: from α(K)exp=0.17 *2*, α(L)exp=0.05 *1*; A_2=+0.03 *6* (1994By01); α(K)exp=0.22 *4*; α(L)exp=0.042 *9*; α(M)exp=0.0054 *20* (1993De26). I_γ: other: 5.2 *6* (1993De26).
446.3 *3*	52 *5*	4010.1+x		3563.8+x	24$^+$	(Q)		Mult.: from A_2=+0.27 *11* (1994By01).
x455.0 *3*	5 *2*							
460.2 *3*	11 *3*	5435.4+x		4975.3+x	(26$^+$,27$^+$)	(D)		A_2=−0.54 *49* (1994By01).
471.7 *1*	851 *20*	638	11$^+$	166	9$^-$	M2	0.547 *8*	α(K)=0.416 *6*; α(L)=0.0981 *14*; α(M)=0.02424 *34*; α(N)=0.00640 *9*; α(O)=0.001426 *20* α(P)=0.0002259 *32*; α(Q)=1.197×10^{-5} *17* Mult.: from α(K)exp=0.47 *2*, α(L)exp=0.110 *4*, α(M)exp=0.035 *3*; A_2=+0.36 *3* (1994By01); α(K)exp=0.41 *8*; α(L)exp=0.10 *2*; α(M)exp=0.023 *4* (1993De26). E_γ: other: 471.8 *2* (1993De26). I_γ: other: 63 *3* (1993De26).
x498.0 *3*	5 *3*					M1	0.1649 *23*	α(K)=0.1334 *19*; α(L)=0.02389 *34*; α(M)=0.00568 *8*; α(N)=0.001488 *21*; α(O)=0.000333 *5* α(P)=5.34×10^{-5} *8*; α(Q)=2.99×10^{-6} *4* Mult.: from α(K)exp=0.10 *1* (1994By01).
509.5 *5*	8 *3*	5435.4+x		4925.4+x	28$^-$			A_2=+1.02 *16* (1994By01).
516.6[b] *2*	30 *10*	638	11$^+$	121	8$^-$	[E3]	0.1183 *17*	α(K)=0.0569 *8*; α(L)=0.0453 *6*; α(M)=0.01210 *17*; α(N)=0.00319 *4*; α(O)=0.000680 *10* α(P)=9.58×10^{-5} *14*; α(Q)=1.918×10^{-6} *27* Mult.: from α(K)exp=0.036 *7*; α(L)exp=0.011 *1*; A_2=−0.12 *5* for both 516γs (1994By01). I_γ: given in 1994By01 as one of the γ doublets.
516.6[b] *2*	150 *10*	1597	13$^-$	1080	12$^+$	(E1)	0.01067 *15*	α(K)=0.00873 *12*; α(L)=0.001478 *21*; α(M)=0.000349 *5*; α(N)=9.08×10^{-5} *13* α(O)=2.005×10^{-5} *28*; α(P)=3.13×10^{-6} *4*; α(Q)=1.590×10^{-7} *22* Mult.: from α(K)exp=0.036 *7*; α(L)exp=0.011 *1*; A_2=−0.12 *5* for both 516γs (1994By01); α(K)exp=0.018 *5*; α(L)exp=0.004 *2* (1993De26). I_γ: given in 1994By01 as one of the γ doublets; other: 19 *3* (1993De26).
x528.0[a] *2*	3.5 *7*							E_γ,I_γ: from 1993De26.
x569.5 *3*	12 *3*							
575.5 *3*	43 *4*	3838.8+x	24	3263.28+x	23$^+$	D		Mult.: from A_2=−0.56 *15* (1994By01).
580.6 *2*	98 *10*	1661	14$^-$	1080	12$^+$	M2	0.292 *4*	α(K)=0.2256 *32*; α(L)=0.0503 *7*; α(M)=0.01235 *17*; α(N)=0.00326 *5*; α(O)=0.000726 *10* α(P)=0.0001153 *16*; α(Q)=6.17×10^{-6} *9* E_γ: other: 580.5 *2* (1993De26). Mult.: from α(K)exp=0.21 *1*, α(L)exp=0.053 *2*, α(M)exp=0.025 *5*; A_2=+0.60 *23* (1994By01). α(K)exp=0.23 *4*; α(L)exp=0.073 *15*; α(M)exp=0.037 *8* (1993De26). I_γ: other: 7.4 *7* (1993De26).

$^{214}_{87}Fr_{127}$-8

(HI,xnγ) 1994By01,1993De26 (continued)

γ(^{214}Fr) (continued)

E_γ †	I_γ ‡	E_i(level)	J_i^π	E_f	J_f^π	Mult.	δ	α	Comments
x586.0 *5*	15 *2*								
591.4 *3*	53 *5*	6360.6+x	30⁻	5769.2+x	29⁻	M1+E2	2.6 *+7−4*	0.035 *4*	α(K)=0.0262 *30*; α(L)=0.0068 *4*; α(M)=0.00169 *10*; α(N)=0.000444 *26*; α(O)=9.7×10^{-5} *6* α(P)=1.46×10^{-5} *10*; α(Q)=5.9×10^{-7} *7* Mult.,δ: from α(K)exp=0.026 *3*; A_2=−0.19 *15* (1994By01).
599.0 *3*	6 *2*	8142.0+y		7543.0+y	36⁻	(D)			Mult.: from A_2=−0.26 *19* (1994By01).
607.5 *3*	25 *7*	1544	12⁺	937	11⁺	(M1)		0.0972 *14*	α(K)=0.0787 *11*; α(L)=0.01402 *20*; α(M)=0.00333 *5*; α(N)=0.000872 *12* α(O)=0.0001950 *27*; α(P)=3.13×10^{-5} *4*; α(Q)=1.754×10^{-6} *25* E_γ: other: 607.0 *2* (1993De26). Mult.: from α(K)exp=0.097 *10*; α(L)exp(607.5γ+608.9γ)=0.016 *3* (1994By01). I_γ: other: 2.6 *5* (1993De26).
608.9 *2*	160 *10*	4925.4+x	28⁻	4316.5+x	27⁻	M1		0.0966 *14*	α(K)=0.0783 *11*; α(L)=0.01394 *20*; α(M)=0.00331 *5*; α(N)=0.000867 *12* α(O)=0.0001939 *27*; α(P)=3.11×10^{-5} *4*; α(Q)=1.744×10^{-6} *24* Mult.: from α(K)exp(607.5+608.9)=0.097 *10*; α(L)exp(607.5+608.9)=0.016 *3*; A_2=−0.29 *8* (1994By01).
614.6 *3*	18 *3*	2777.6+x		2163+x	19⁺	(D)			Mult.: from A_2=−1.18 *17* (1994By01).
645.8 *2*	100 *10*	2808.82+x	20⁻	2163+x	19⁺	E1		0.00687 *10*	α(K)=0.00564 *8*; α(L)=0.000935 *13*; α(M)=0.0002199 *31*; α(N)=5.73×10^{-5} *8* α(O)=1.270×10^{-5} *18*; α(P)=1.995×10^{-6} *28*; α(Q)=1.042×10^{-7} *15* Mult.: from α(K)exp=0.005 *1*; A_2=−0.17 *8* (1994By01).
665.4 *2*	295 *10*	4229.2+x	25⁻	3563.8+x	24⁺	E1		0.00649 *9*	α(K)=0.00533 *7*; α(L)=0.000881 *12*; α(M)=0.0002071 *29*; α(N)=5.40×10^{-5} *8* α(O)=1.196×10^{-5} *17*; α(P)=1.881×10^{-6} *26*; α(Q)=9.86×10^{-8} *14* Mult.: from α(K)exp<0.01 (contaminated); A_2=−0.22 *4* (1994By01).
679.9 *3*	40 *5*	4575.3+x	26⁺	3895.4+x	25⁺	M1		0.0722 *10*	α(K)=0.0585 *8*; α(L)=0.01039 *15*; α(M)=0.002466 *35*; α(N)=0.000646 *9* α(O)=0.0001444 *20*; α(P)=2.320×10^{-5} *33*; α(Q)=1.301×10^{-6} *18* Mult.: from α(K)exp=0.056 *26*; A_2=−0.22 *10* (1994By01).
683.8 *3*	7 *3*	5000.3+x		4316.5+x	27⁻				
x694.5 *3*	6 *3*								
735.0 *3*	9 *3*	7547.0+y	(35⁺)	6812.0+y	(34⁺)	M1		0.0588 *8*	α(K)=0.0477 *7*; α(L)=0.00845 *12*; α(M)=0.002004 *28*; α(N)=0.000525 *7* α(O)=0.0001174 *16*; α(P)=1.886×10^{-5} *26*; α(Q)=1.058×10^{-6} *15* Mult.: from α(K)exp=0.058 *12*; A_2=−0.62 *22* (1994By01).
738.5 *2*	90 *5*	2901.48+x	20⁻	2163+x	19⁺	E1		0.00533 *7*	α(K)=0.00438 *6*; α(L)=0.000718 *10*; α(M)=0.0001686 *24*;

$^{214}_{87}Fr_{127}$-9

(HI,xnγ) 1994By01,1993De26 (continued)

γ(^{214}Fr) (continued)

E_γ †	I_γ ‡	E_i(level)	J_i^π	E_f	J_f^π	Mult.	δ	α	Comments
									α(N)=4.40×10^{-5} *6* α(O)=9.75×10^{-6} *14*; α(P)=1.537×10^{-6} *22*; α(Q)=8.15×10^{-8} *11* E_γ: other: 738.3 *2* (1993De26). Mult.: from α(K)exp=0.006 *1* (1994By01). I_γ: other: 11 *2* (1993De26).
752.7 *2*	36 *5*	4316.5+x	27$^-$	3563.8+x	24$^+$	E3		0.0407 *6*	α(K)=0.0258 *4*; α(L)=0.01115 *16*; α(M)=0.00288 *4*; α(N)=0.000760 *11*; α(O)=0.0001640 *23* α(P)=2.399×10^{-5} *34*; α(Q)=7.23×10^{-7} *10* Mult.: from α(K)exp=0.035 *3*; α(L)exp=0.012 *2*; A_2=+0.66 *6* (1994By01).
x757.6 *3*	5 *3*					(M2)		0.1353 *19*	α(K)=0.1058 *15*; α(L)=0.02225 *31*; α(M)=0.00542 *8*; α(N)=0.001426 *20*; α(O)=0.000318 *4* α(P)=5.07×10^{-5} *7*; α(Q)=2.74×10^{-6} *4* Mult.: from α(K)exp=0.09 *3*; A_2=0.46 *26* (1994By01).
781.0 *4*	3 *1*	7256.0+y		6475+y	33$^+$				
809[c]		4704.0+x		3895.4+x	25$^+$				E_γ: tentative transition, not observed (1994By01).
810.2 *3*	2 *1*	8656.3+y		7846.1+y					
844.0 *2*	80 *5*	5769.2+x	29$^-$	4925.4+x	28$^-$	M1,E2		0.026 *15*	α(K)=0.021 *12*; α(L)=0.0040 *19*; α(M)=1.0×10^{-3} *4*; α(N)=2.5×10^{-4} *11*; α(O)=5.6×10^{-5} *26* α(P)=9.E−6 *4*; α(Q)=4.7×10^{-7} *27* Mult.: from α(K)exp=0.014 *1*, α(L)exp=0.0018 *3*; A_2=−0.01 *5* (1994By01).
853.2 *3*	15 *5*	5557.2+x		4704.0+x					A_2=+0.14 *14* (1994By01).
858.0 *2*	36 *5*	4196.0+x	25$^-$	3338.0+x	24$^+$	(E1)		0.00404 *6*	α(K)=0.00333 *5*; α(L)=0.000539 *8*; α(M)=0.0001264 *18*; α(N)=3.29×10^{-5} *5*; α(O)=7.32×10^{-6} *10* α(P)=1.159×10^{-6} *16*; α(Q)=6.24×10^{-8} *9* Mult.: from A_2=−0.17 *10* (1994By01).
888.6 *3*	39 *5*	5205.0+x	(28$^+$)	4316.5+x	27$^-$				A_2=+0.27 *31* (1994By01).
891.2[&c] *5*	≤72	4229.2+x	25$^-$	3338.0+x	24$^+$	[E1]		0.00377 *5*	α(K)=0.00311 *4*; α(L)=0.000502 *7*; α(M)=0.0001176 *17*; α(N)=3.07×10^{-5} *4*; α(O)=6.82×10^{-6} *10* α(P)=1.080×10^{-6} *15*; α(Q)=5.83×10^{-8} *8*
891.5 *2*	630 *20*	3054.50+x	21$^+$	2163+x	19$^+$	E2		0.01069 *15*	α(K)=0.00819 *11*; α(L)=0.001890 *26*; α(M)=0.000463 *6*; α(N)=0.0001213 *17* α(O)=2.66×10^{-5} *4*; α(P)=4.06×10^{-6} *6*; α(Q)=1.759×10^{-7} *25* E_γ: other: 892.0 *2* (1993De26). Mult.: from α(K)exp=0.0070 *15*, α(L)exp=0.0014 *5*; A_2=+0.47 *5* (1994By01). α(K)exp=0.0070 *10* (1993De26). I_γ: other: 47 *9* (1993De26).
906.7 *2*	70 *6*	1544	12$^+$	638	11$^+$	M1+E2	1.01 *15*	0.0220 *19*	α(K)=0.0176 *16*; α(L)=0.00332 *25*; α(M)=0.00079 *6*; α(N)=0.000208 *15*; α(O)=4.62×10^{-5} *34* α(P)=7.3×10^{-6} *6*; α(Q)=3.87×10^{-7} *35* E_γ: other: 906.5 *2* (1993De26). Mult.,δ: from α(K)exp=0.017 *1*; A_2=−0.19 *3* (1994By01);

$^{214}_{87}Fr_{127}$-10

(HI,xnγ) 1994By01,1993De26 (continued)

γ(^{214}Fr) (continued)

E_γ †	I_γ ‡	E_i(level)	J_i^π	E_f	J_f^π	Mult.	α	Comments
								α(K)exp=0.039 *8*; α(L)exp=0.0065 *12* (1993De26). I_γ: other: 3.0 *3* (1993De26).
978.5 *3*	30 *6*	4316.5+x	27^-	3338.0+x	24^+	E3	0.02154 *30*	α(K)=0.01511 *21*; α(L)=0.00481 *7*; α(M)=0.001217 *17*; α(N)=0.000320 *4*; α(O)=6.97×10^{-5} *10* α(P)=1.046×10^{-5} *15*; α(Q)=3.88×10^{-7} *5* Mult.: from α(K)exp=0.021 *2*, α(L)exp=0.005 *1*; A_2=+0.58 *13* (1994By01).
998.0 *3*	18 *3*	1636		638	11^+	(D)		Mult.: from A_2=−0.11 *9* (1994By01).
1014.9 *3*	49 *5*	5331.4+x	28^+	4316.5+x	27^-	E1	0.00299 *4*	α(K)=0.002469 *35*; α(L)=0.000395 *6*; α(M)=9.24×10^{-5} *13*; α(N)=2.410×10^{-5} *34* α(O)=5.36×10^{-6} *8*; α(P)=8.52×10^{-7} *12*; α(Q)=4.65×10^{-8} *7* Mult.: from α(K)exp<0.003; A_2=−0.12 *14* (1994By01).
1023.1 *2*	791 *26*	1661	14^-	638	11^+	E3	0.01944 *27*	α(K)=0.01382 *19*; α(L)=0.00421 *6*; α(M)=0.001062 *15*; α(N)=0.000279 *4*; α(O)=6.09×10^{-5} *9* α(P)=9.17×10^{-6} *13*; α(Q)=3.50×10^{-7} *5* E_γ: other: 1023.0 *2* (1993De26). Mult.: α(K)exp=0.0120 *5*, α(L)exp=0.0048 *2*, α(M)exp=0.0010 *2*; A_2=+0.52 *2* (1994By01); α(K)exp=0.015 *3*; α(L)exp=0.0042 *8*; α(M)exp=0.0008 *3* (1993De26). I_γ: other: 84 *4* (1993De26).
1068.0 *3*	35 *5*	7543.0+y	36^-	6475+y	33^+	E3	0.01764 *25*	α(K)=0.01268 *18*; α(L)=0.00372 *5*; α(M)=0.000934 *13*; α(N)=0.0002455 *34* α(O)=5.36×10^{-5} *8*; α(P)=8.10×10^{-6} *11*; α(Q)=3.18×10^{-7} *4* Mult.: from α(K)exp=0.014 *4*, α(L)exp=0.007 *2*; A_2=0.65 *17* (1994By01).
1080.5 *5*	7 *3*	4975.3+x	$(26^+,27^+)$	3895.4+x	25^+			Mult.: from A_2=+0.07 *17* (1994By01).
1200.8 *3*	24 *3*	1367	$(12)^+$	166	9^-	(E3)	0.01361 *19*	α(K)=0.01005 *14*; α(L)=0.00267 *4*; α(M)=0.000666 *9*; α(N)=0.0001749 *25*; α(O)=3.83×10^{-5} *5* α(P)=5.85×10^{-6} *8*; α(Q)=2.446×10^{-7} *34* Mult.: from α(K)exp=0.010 *3*; A_2=+0.33 *10* (1994By01).
1240.7 *3*	5 *2*	5557.2+x		4316.5+x	27^-			
x1293.2 *5*	10 *2*					(Q)		Mult.: from A_2=0.37 *11* (1994By01).
1310.9 *5*	6 *3*	5627.4+x		4316.5+x	27^-			A_2=+0.10 *25* (1994By01).
1316.4 *3*	15 *5*	6521.4+x		5205.0+x	(28^+)	E2	0.00511 *7*	α(K)=0.00406 *6*; α(L)=0.000783 *11*; α(M)=0.0001880 *26*; α(N)=4.92×10^{-5} *7* α(O)=1.089×10^{-5} *15*; α(P)=1.705×10^{-6} *24*; α(Q)=8.49×10^{-8} *12* Mult.: from α(K)exp=0.003 *1*; A_2=+0.85 *9* (1994By01).
1321.9 *3*	19 *3*	5638.7+x	28^+	4316.5+x	27^-	E1	1.94×10^{-3} *3*	α(K)=0.001564 *22*; α(L)=0.0002462 *34*; α(M)=5.75×10^{-5} *8*; α(N)=1.500×10^{-5} *21* α(O)=3.34×10^{-6} *5*; α(P)=5.34×10^{-7} *7*; α(Q)=2.97×10^{-8} *4* Mult.: from α(K)exp=0.001 *2*; A_2=+0.10 *35* (1994By01).
1453.0 *5*	9 *2*	5769.2+x	29^-	4316.5+x	27^-	(Q)		Mult.: from A_2=+0.41 *16* (1994By01).

$^{214}_{87}Fr_{127}$-11

(HI,xnγ) 1994By01,1993De26 (continued)

$\gamma(^{214}Fr)$ (continued)

† From 1994By01, unless otherwise noted.
‡ From 1994By01 following $^{208}Pb(^{11}B,5n\gamma)$ reaction at 75 MeV bombarding energy.
# Existence was inferred by coincidences (1994By01).
@ In self-coincidence (1994By01).
& Unconfirmed transition (1994By01).
a Measurement of 1993De26; γ is not listed in 1994By01.
b Multiply placed.
c Placement of transition in the level scheme is uncertain.
x γ ray not placed in level scheme.

$^{214}_{87}Fr_{127}$-12

(HI,xnγ) 1994By01,1993De26

Level Scheme

Intensities: Relative I_γ

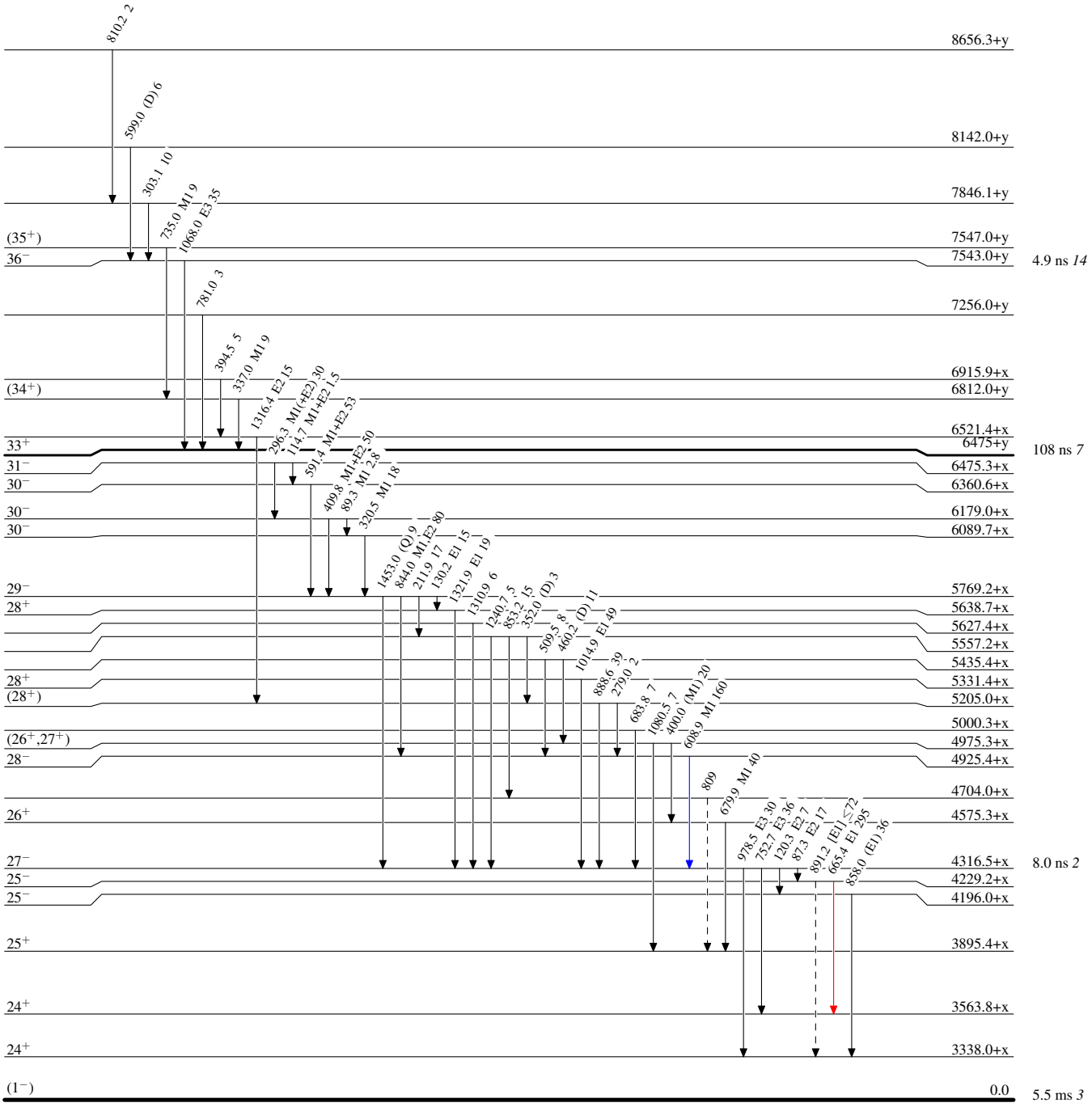
Legend

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

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

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

γ Decay (Uncertain)



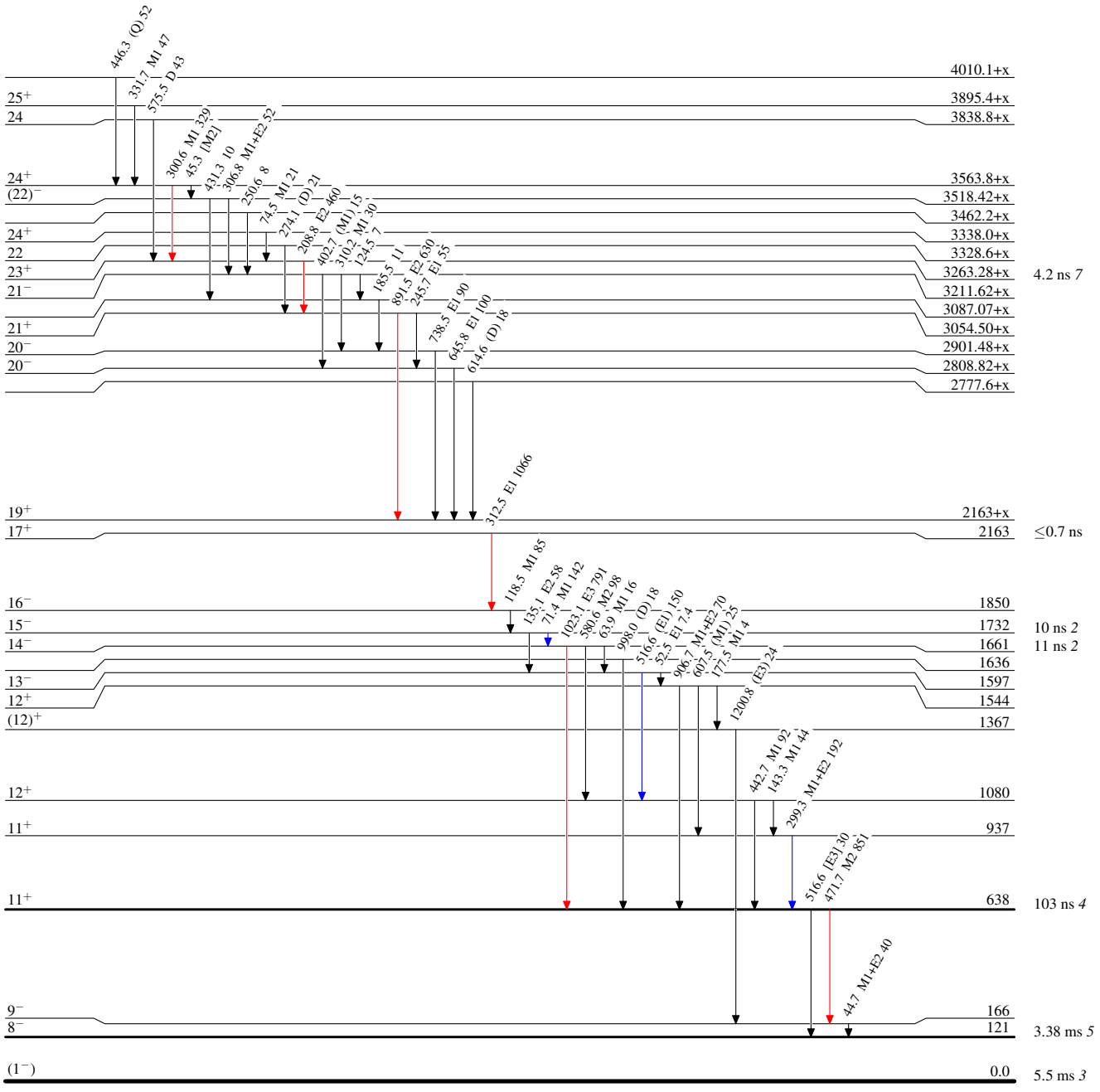
$^{214}_{87}Fr_{127}$

(HI,xnγ) 1994By01,1993De26

Level Scheme (continued)

Intensities: Relative I_γ

Legend
$I_\gamma < 2\% \times I_\gamma^{max}$
$I_\gamma < 10\% \times I_\gamma^{max}$
$I_\gamma > 10\% \times I_\gamma^{max}$



$^{214}_{87}Fr_{127}$