(HI,xnγ)

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	M. S. Basunia	NDS 181, 475 (2022)	1-Jan-2022

2010Da04: ^{209}Bi(^{9}Be,X), E=44.0, 50.0. 60.0 MeV, − measured fusion cross section.

The decay scheme of levels below E≤2538 keV was constructed by 1971MaXH from their $\gamma\gamma$ coincidence data, and it was confirmed by 1976Ha37. The main cascade of strongly populated levels above 2538 keV and up to 6573 keV was added by 1979Ho06 from their coincidence data; the levels above 6573-keV and the weakly populated side cascades were built by 1986By01 and 1989By01. Delayed and out-of-beam coincidences were also taken by 1989By01, designed to study the high energy isomeric state. The placements of 1259.1 and 563.3 gammas to feed the 6725-keV level were based on the coincidences observed with the 621.8-keV γ (1991ByZZ). The level scheme shown in 1989By01 is presented here.

2011Ka30: Pt(^{36}S,X), E=5.96 MeV/nucleon and W(^{48}Ca,X), E=5.41 MeV/nucleon − measured differential cross section dσ/dΩ.

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204Hg(14N,5nγ)         E=94 MeV, pulsed beam         1974Re09
205Tl(12C,4nγ)         E=71− to 80-MeV pulsed beams   1976Ha37
205Tl(13C,5nγ)         E=72− to 86-MeV pulsed beams   1979Ho06
205Tl(12C,4nγ),        205Tl(13C,5nγ)        E=77-96 MeV; and
198Pt(19F,5nγ)         E=102 MeV, pulsed beam        1986By01
205Tl(13C,5nγ)         E=90 MeV, pulsed beam         1989By01
238U    fragmentation at E/A=900 MeV           2006Po01
                                 Other: 1971MaXH.
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^{213}Fr Levels

E(level)†	J$^{\pi}$‡	T$_{1/2}$#	Comments
0.0	9/2$^-$	34.17 s *6*	Configuration: π ($h^{+1}_{9/2}$). T$_{1/2}$: From Adopted Levels.
1188.80 *10*	13/2$^-$	<2.1 ns	J$^{\pi}$: Configuration: π ($h^{+1}_{9/2}$)⊗2$^+$.
1411.00 *15*	17/2$^-$	18 ns *1*	Configuration: π ($h^{+1}_{9/2}$)⊗4$^+$. T$_{1/2}$: Other: T$_{1/2}$≤60 ns − measured by delayed coincidence method (1976Ha37). g(1411 level)=0.88 *16* (1986By01).
1590.40 *18*	21/2$^-$	505 ns *20*	Configuration: π ($h^{+1}_{9/2}$)⊗6$^+$. %Isomeric production ratio=22 *2* (2013Ba29), E=1 GeV/nucleon, from ^{238}U fragmentation. T$_{1/2}$: Weighted average of 499 ns *21* (1986By01) and 510 ns *20* (1976Ha37). Uncertainty is the lower input value. Other: ≈1 μs (1971MaXH). g(1590 level)=0.888 *3* (1977Be56,1976Ha37); 0.888 *4* (1979Ho06); 0.89 *2* (1986By01).
1856.30 *20*	23/2$^-$	<1.4 ns	Configuration: π ($h^{+2}_{9/2}$,$f^{+1}_{7/2}$).
2537.61 *23*	29/2$^+$	238 ns *6*	Q=−0.70 *7* Q: From 1990By03, deduced using the B(E2) value for the 8$^+$ to 6$^+$ transition in ^{212}Rn and an effective charge of 1.5e. Other: Q=0.81 *4* was obtained by 1990Ha30 by level mixing spectroscopy. Configuration: π ($h^{+2}_{9/2}$,$i^{+1}_{13/2}$). %Isomeric production ratio=23 *2* (2013Ba29), E=1 GeV/nucleon, from ^{238}U fragmentation; and Isomeric population ratio %R$_{exp}$=12 *8* (2006Po01), E=900 MeV/nucleon. T$_{1/2}$: From 1976Ha37. Others: 243 ns *21* (1986By01) and ≈0.5 μs (1971MaXH). g(2537 level)=1.0494 *18* (1977Be56,1976Ha37), 1.04 *2* (1974Re09), 1.055 *5* (1989By01) by γ(H,θ,t).
2740.2 *3*	27/2$^-$	<7 ns	Configuration: π ($h^{+2}_{9/2}$,$f^{+1}_{7/2}$)⊗2$^+$.
2950.5 *3*	31/2$^-$	<2.1 ns	Configuration: π ($h^{+2}_{9/2}$,$f^{+1}_{7/2}$)⊗4$^+$.
3427.34 *24*	33/2$^+$	<2.1 ns	Configuration: π ($h^{+2}_{9/2}$,$i^{+1}_{13/2}$)⊗2$^+$.
3489.2 *4*	33/2		
3655.4 *4*	37/2$^+$	2.4 ns *7*	Configuration: π ($h^{+2}_{9/2}$,$i^{+1}_{13/2}$)⊗4$^+$. T$_{1/2}$: Other: 4.1 ns (1979Ho06).
4029.2 *5*			
4082.9 *4*	39/2$^+$	<1.4 ns	

Continued on next page (footnotes at end of table)

(HI,xnγ) (continued)

^{213}Fr Levels (continued)

E(level)†	Jπ‡	$T_{1/2}$#	Comments
4653.6? *11*			
4675.4 *4*		<2.1 ns	
4695.9 *4*	39/2⁻	<2.1 ns	
4898.5 *4*	41/2⁻	<2.8 ns	
4982.0 *6*			
4992.7 *4*	45/2⁻	13 ns *2*	μ=23.2 *7* Jπ: 909.8γ E3 to 39/2⁺ state, 94.4γ E2 to 41/2⁻ state. g(4993 level)=0.990 *25* (1979Ho06), 1.03 *3* (1986By01) by γ(H,θ,t). Configuration: π ($h^{+3}_{9/2}$,$i^{+2}_{13/2}$). $T_{1/2}$: Other: 13.5 ns (1979Ho06). μ: From 1986By01 (time-differential perturbed angular distribution (TDPAD) measurements).
5001.9 *5*			
5220.2 *5*			
5506.3 *4*	43/2⁻	<2.1 ns	
5785.9 *4*	47/2⁻	<1.4 ns	
5814.8 *5*	(45/2⁺)		
5951.5 *5*			
6102.7 *6*	49/2⁻		
6334.1 *5*			
6572.9 *4*	49/2⁺	<2.1 ns	$T_{1/2}$: Other: 7 ns (1979Ho06).
6715.3 *5*	53/2⁺	6.2 ns *14*	Configuration: π ([$h^{+4}_{9/2}$,$i^{+1}_{13/2}$]$_{37/2^+}$) ν ([$p^{-1}_{1/2}$,$j^{+1}_{15/2}$]$_{8^+}$).
6724.5 *7*	55/2⁺		Jπ: Assignment based on 9.2γ M1 to 53/2⁺ state (1989By01). $T_{1/2}$: The half-life 6.2 ns *14* was determined by 1989By01 from the 142- and 929-keV γ's deexciting the 6715-keV level. Since the 621.8γ was observed in coincidence with the 1259.1γ (from 7983.6) and 563.3γ (from 7288.0), $T_{1/2}$(6724-keV level) is short. The same half-life of 6.2 ns *14* was assigned to both 6715- and 6724-keV levels.
6803.0 *8*	(55/2)		Jπ: From Adopted Levels.
6812.8 *6*			
7135.0 *8*			
7247.5 *8*			
7288.0 *7*	57/2⁺	<2.1 ns	
7374.4 *8*	(57/2,59/2)		E(level): From Adopted Levels.
7541.8 *7*	(57/2)		E(level): From Adopted Levels.
7723.7 *7*	59/2⁺		Configuration: π ([$h^{+3}_{9/2}$,$i^{+1}_{13/2}$,$f_{7/2}$]$_{39/2^+}$) ν ([$p^{-2}_{1/2}$,$g_{9/2}$,$i_{11/2}$]$_{10^+}$).
7983.6 *7*	61/2⁻	<3.5 ns	Jπ: 1259γ E3 to 55/2⁺ state. Possible configuration: π([$h^{+3}_{9/2}$,$i^{+2}_{13/2}$]$_{45/2^-}$) ν ([$p^{-1}_{1/2}$,$j^{+1}_{15/2}$]$_{8^+}$). $T_{1/2}$: From 1989By01.
8094.9 *7*	65/2⁻	3.1 μs *2*	μ=22.5 *2*; Q=−2.19 *53* Configuration: π ([$h^{+3}_{9/2}$,$i^{+2}_{13/2}$]$_{45/2^-}$) ν ([$p^{-2}_{1/2}$,$g_{9/2}$,$i_{11/2}$]$_{10^+}$). μ: From 1989By01 (time-differential perturbed angular distribution (TDPAD) measurements). Q: From 1991Ha02, relative to Q(29/2⁺ state)=−0.70 *7*. In 1990Ha30, Q=2.51 *51* was obtained by level mixing spectroscopy, a g-factor of 0.695 *7* was used.

† Deduced by the evaluator from a least squares fit to the γ-ray energies. Eγ related to uncertain placement and expected ones were ignored.

‡ From 1989By01. The assignments were based on the γ-ray transition multipolarities, determined by the γ-ray angular distributions and conversion electron, linear polarization measurements of 1979Ho06, transition strengths, and shell states in neighboring nuclei.

Obtained by 1986By01 from pulsed-beam, chopped-beam, γγ(t) and n,γ(t) measurements, unless otherwise noted.

(HI,xnγ) (continued)

γ(^{213}Fr)

E_γ [†]	I_γ [a]	E_i(level)	J^π_i	E_f	J^π_f	Mult. [b]	α [c]	Comments
(9.2[#])		6724.5	55/2+	6715.3	53/2+	M1	778 *11*	α(M)=584 *8* α(N)=153.5 *21*; α(O)=34.3 *5*; α(P)=5.50 *8*; α(Q)=0.309 *4* Mult.: α(exp)(M1)=828.1. Other multipolarities were ruled out by 1989By01 by considering the transition strength limits deduced from the measured $T_{1/2}$=6.2 ns which was assigned also to the 6724-keV level. 0.21 *4*<Iγ<0.51 *6* from intensity balance at the 6724-keV and 6715-keV levels, assuming that the 9.2-keV transition is M1 and the 621.8γ is an E3 transition. An assumption of E1 multipolarity and the intensity balance would yield 10<Iγ<24 and 0.002<B(E1)(W.u.)<0.005.
(42.3[#])		4695.9	39/2−	4653.6?				
[x]60.3[@] *3*								
(78.4[#])		6803.0	(55/2)	6724.5	55/2+			
(86.3[#])		7374.4	(57/2,59/2)	7288.0	57/2+			
94.4 *3*	4 *1*	4992.7	45/2−	4898.5	41/2−	E2	11.49 *24*	A_2=+0.09 *26* (1986By01) α(L)=8.46 *17*; α(M)=2.29 *5* α(N)=0.601 *12*; α(O)=0.1244 *26*; α(P)=0.01601 *33*; α(Q)=3.84×10^{-5} *7* I_γ: from Iγ(94.4γ)/Iγ(909.7γ)=4 *1*/117 *2*, measured by 1986By01. Iγ(94.4γ) was not listed by 1991ByZZ.
111.3 *2*	80.0 *24*	8094.9	65/2−	7983.6	61/2−	E2	5.66 *9*	α(K)=0.329 *5*; α(L)=3.92 *6*; α(M)=1.063 *17* α(N)=0.279 *5*; α(O)=0.0578 *9*; α(P)=0.00747 *12*; α(Q)=2.235×10^{-5} *34* A_2=+0.17 *13* or +0.35 *15* (1986By01 − contaminant peaks were comparable > 1/3). Mult.: From α(exp)=6.2 *3*, determined from the delayed intensity data (1989By01).
(112.2[#])		7247.5		7135.0				
127.2 *4*	11.6 *22*	7374.4	(57/2,59/2)	7247.5				
142.3 *3*	93 *12*	6715.3	53/2+	6572.9	49/2+	E2	2.027 *33*	α(K)=0.292 *4*; α(L)=1.278 *22*; α(M)=0.345 *6* α(N)=0.0906 *15*; α(O)=0.01883 *32*; α(P)=0.00245 *4*; α(Q)=1.083×10^{-5} *16* A_2=+0.04 *10* or +0.22 *7* and A_4=−0.16 *14* or −0.20 *10* (1986By01 − contaminant peaks were comparable > 1/3). Mult.: From total α<40, from intensity balance in 1986By01.
179.4 *1*	538 *24*	1590.40	21/2−	1411.00	17/2−	E2	0.823 *12*	α(K)=0.2013 *28*; α(L)=0.458 *7*; α(M)=0.1234 *18* α(N)=0.0324 *5*; α(O)=0.00675 *10*; α(P)=0.000890 *13*; α(Q)=5.84×10^{-6} *8* A_2=+0.73 *8* or +0.16 *1* and A_4=−0.01 *1* or +0.00 *3* (1986By01 − contaminant peaks were comparable > 1/3). Mult.: From total α=0.83 *18*, deduced from delayed intensity measurement (1986By01).
182.0 *3*	42 *8*	7723.7	59/2+	7541.8	(57/2)	D		A_2=−0.007 *272* or −0.23 *20* (1986By01 − contaminant peaks were

$^{213}_{87}Fr_{126}$-3

(HI,xnγ) (continued)

γ(^{213}Fr) (continued)

E_γ[†]	I_γ[a]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[b]	δ	α[c]	Comments
									comparable > 1/3). The angular distribution suggests a dipole character for the 182.5γ. α(E1)=0.1106, α(M1)=2.616.
202.8[d] *4*		2740.2	$27/2^-$	2537.61	$29/2^+$				
210.4 *3*	<43	2950.5	$31/2^-$	2740.2	$27/2^-$	(E2)		0.462 *7*	A_2=+0.29 *79*; A_4=−0.05 *11* (1986By01) α(K)=0.1474 *21*; α(L)=0.2319 *35*; α(M)=0.0622 *9* α(N)=0.01631 *25*; α(O)=0.00341 *5*; α(P)=0.000454 *7*; α(Q)=3.92×10^{-6} *6* Iγ<38 *5* (1991ByZZ).
222.2 *1*	694 *30*	1411.00	$17/2^-$	1188.80	$13/2^-$	E2		0.382 *5*	α(K)=0.1318 *18*; α(L)=0.1845 *26*; α(M)=0.0494 *7* α(N)=0.01295 *18*; α(O)=0.00271 *4*; α(P)=0.000362 *5*; α(Q)=3.43×10^{-6} *5* A_2=+0.08 *1* or +0.17 *2* and A_4=+0.00 *2* or −0.01 *2* (1986By01). Mult.: From α(L)exp=0.16 *6*, α(M)exp=0.048 *20* (1986By01).
(227.5[#])		5220.2		4992.7	$45/2^-$				
228.1 *2*	425 *26*	3655.4	$37/2^+$	3427.34	$33/2^+$	E2		0.349 *5*	A_2=+0.293 *14*; A_4=−0.091 *19* (1979Ho06) α(K)=0.1248 *18*; α(L)=0.1655 *24*; α(M)=0.0443 *6* α(N)=0.01161 *17*; α(O)=0.002433 *35*; α(P)=0.000325 *5*; α(Q)=3.22×10^{-6} *5* Mult.: From α(L)exp=0.12 *5*, α(M)exp=0.067 *23* (1986By01), pol=0.81 *45* (1979Ho06). A_2=+0.22 *3* or +0.26 *6* and A_4=−0.02 *4* or −0.09 *8* (1986By01).
238[&]		5220.2		4982.0					
239.0 *4*	19 *9*	6572.9	$49/2^+$	6334.1					
253.6 *4*	131 *9*	7541.8	(57/2)	7288.0	$57/2^+$				
265.9 *1*	283 *13*	1856.30	$23/2^-$	1590.40	$21/2^-$	M1+E2	0.9 *+11−9*	0.60 *31*	α(N)=0.0074 *9*; α(O)=0.00161 *25*; α(P)=0.00024 *5*; α(Q)=1.0×10^{-5} *6* α(K)=0.45 *29*; α(L)=0.113 *20*; α(M)=0.028 *4* A_2=−0.11 *1* or −0.09 *2* and A_4=+0.03 *1* or +0.01 *3*. Mult.: From total α=0.76 *18* (1986By01).
279.6 *2*	117 *11*	5785.9	$47/2^-$	5506.3	$43/2^-$	E2		0.1797 *25*	α(K)=0.0812 *11*; α(L)=0.0729 *10*; α(M)=0.01932 *28* α(N)=0.00507 *7*; α(O)=0.001068 *15*; α(P)=0.0001452 *21*; α(Q)=1.989×10^{-6} *28* A_2=+0.19 *2* or +0.23 *4* and A_4=−0.03 *3* or +0.01 *7* (1986By01 – contaminant peaks were comparable > 1/3). Mult.: From α(K)exp=0.06 *4* (1986By01).
294.1 *3*	17 *4*	7541.8	(57/2)	7247.5					
306.5 *4*	15.4 *24*	4982.0		4675.4					α(E1)=0.0326, α(M1)=0.614, α(E2)=0.136.
308.3[‡] *3*	18 *6*	5814.8	$(45/2^+)$	5506.3	$43/2^-$	(E1)		0.0322 *5*	α(K)=0.0260 *4*; α(L)=0.00467 *7*; α(M)=0.001109 *16* A_2=−0.24 *17*; A_4=−0.08 *23* (1986By01) α(N)=0.000288 *4*; α(O)=6.32×10^{-5} *9*; α(P)=9.66×10^{-6} *14*; α(Q)=4.53×10^{-7} *6*

(HI,xnγ) (continued)

γ(^{213}Fr) (continued)

E_γ[†]	I_γ[a]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[b]	δ	α[c]	Comments
316.8 *4*	24 *4*	6102.7	49/2⁻	5785.9	47/2⁻	(M1+E2)		0.34 *22*	α(K)=0.26 *20*; α(L)=0.064 *18*; α(M)=0.016 *4* α(N)=0.00411 *99*; α(O)=9.0×10^{-4} *24*; α(P)=1.4×10^{-4} *5*; α(Q)=6.E−6 *4* A_2=−0.78 *3*, A_4=+0.06 *4* or A_2=−0.81 *11* (1986By01). Mult.: the measured large A_2 value indicated some quadrupole admixture. Authors′ earlier assignment of E1 (1986By01) from conversion electron measurement has been withdrawn (1991ByZZ). Since the ce(K 317γ) line was contaminated by the ce(M 222γ), the angular distribution measurements were more reliable for determination of its multipolarity. E1+M2 with any significant amount of M2 admixture is ruled out because of short half-life of the 6102-keV level.
322.2 *5*	13 *4*	7135.0		6812.8					
326.3 *4*	16 *5*	5001.9		4675.4		(D)		0.0283	A_2=−0.11 *4*, A_4=−0.02 *6* or A_2=−0.09 *10* (1986By01 – contaminant peaks were comparable > 1/3). α: for E1, as implied by the intensity balance at the 4675-keV level. α(M1)=0.517. The angular distribution is consistent with a dipole transition.
349.5[‡] *3*	75 *4*	7723.7	59/2⁺	7374.4	(57/2,59/2)	D			A_2=−0.41 *3*; A_4=−0.05 *5* (1986By01) Mult.: No ce line was listed for this transition. It is assumed that ce lines were weak, suggesting E1 or E2 multipolarity. The angular distribution coefficient listed is in agreement with a dipole character. α(E1)=0.0243.
371.2[‡] *2*	125 *10*	8094.9	65/2⁻	7723.7	59/2⁺	E3		0.372 *5*	A_2=+0.03 *6*; A_4=+0.04 *8* (1986By01) α(K)=0.1160 *16*; α(L)=0.1879 *27*; α(M)=0.0513 *7* α(N)=0.01356 *19*; α(O)=0.00286 *4*; α(P)=0.000392 *6*; α(Q)=4.99×10^{-6} *7* Mult.: α(exp)=0.35 *7*, deduced by 1989By01 (method was not discussed), and E3 multipolarity was assigned. Although α(exp) is also consistent with an M1 transition [α(M1)=0.3638], if its placement is correct, $T_{1/2}$(8094 level) suggests E3 multipolarity.
382.7[‡] *3*	27 *3*	6334.1		5951.5					A_2=+0.13 *6*; A_4=+0.05 *8* (1986By01) Mult.: α(K)exp=0.20 *7* and M1/E2 in 1986By01 but different placement in 1986By01 compared to that in 1989By01.
413.0 *2*	129 *3*	2950.5	31/2⁻	2537.61	29/2⁺	E1		0.01695 *24*	A_2=−0.222 *24*; A_4=+0.034 *34* (1979Ho06) A_2=−0.16 *3*; A_4=+0.08 *5* (1986By01) α(K)=0.01381 *19*; α(L)=0.002396 *34*; α(M)=0.000567 *8* α(N)=0.0001475 *21*; α(O)=3.25×10^{-5} *5*; α(P)=5.03×10^{-6} *7*; α(Q)=2.474×10^{-7} *35* Mult.: From α(K)exp=0.047 *24* (1986By01), pol=0.36 *12* (1979Ho06).
427.5 *1*	255 *11*	4082.9	39/2⁺	3655.4	37/2⁺	M1+E2	0.10 *3*	0.246 *4*	A_2=−0.424 *13*; A_4=+0.023 *19* (1979Ho06)

From ENSDF

$^{213}_{87}Fr_{126}$-5

(HI,xnγ) (continued)

γ(^{213}Fr) (continued)

E_γ[†]	I_γ[a]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[b]	α[c]	Comments
								A_2=−0.32 *2*; A_4=+0.01 *2* (1986By01) α(K)=0.1992 *30*; α(L)=0.0359 *5*; α(M)=0.00854 *12* α(N)=0.002237 *32*; α(O)=0.000500 *7*; α(P)=8.02×10^{-5} *12*; α(Q)=4.47×10^{-6} *7* Mult.: From α(K)exp=0.28 *7*, α(L)exp=0.051 *15*, α(M)exp=0.018 (5) (1986By01), pol=−0.32 *8* (1979Ho06).
435.6 *4*	8.4 *20*	7723.7	$59/2^+$	7288.0	$57/2^+$			
469.7[d] *4*		6572.9	$49/2^+$	6102.7	$49/2^-$			E_γ: from 1986By01; transition was not listed by 1991ByZZ.
476.9 *2*	137 *6*	3427.34	$33/2^+$	2950.5	$31/2^-$	E1	0.01255 *18*	A_2=−0.257 *20*; A_4=+0.059 *29* (1979Ho06) A_2=−0.21 *2*; A_4=+0.05 *2* (1986By01) α(K)=0.01025 *14*; α(L)=0.001751 *25*; α(M)=0.000413 *6* α(N)=0.0001077 *15*; α(O)=2.376×10^{-5} *33*; α(P)=3.70×10^{-6} *5*; α(Q)=1.858×10^{-7} *26* Mult.: α(K)exp<0.047 (1986By01), pol=0.25 *12* (1979Ho06).
478.7 *3*	25 *4*	6812.8		6334.1				
538.7 *3*	27.8 *10*	3489.2	33/2	2950.5	$31/2^-$	(D)		A_2=−0.47 *6* (1986By01) α(E1)=0.00981, α(M1)=0.1337, α(E2)=0.0310.
540.0 *3*	17.2 *10*	4029.2		3489.2	33/2			
545.1 *5*	<76	5220.2		4675.4				
563.3 *3*	136 *6*	7288.0	$57/2^+$	6724.5	$55/2^+$	M1	0.1187 *17*	A_2=−0.47 *6*; A_4=+0.23 *10* (1986By01) α(K)=0.0961 *14*; α(L)=0.01716 *24*; α(M)=0.00408 *6* α(N)=0.001068 *15*; α(O)=0.0002388 *34*; α(P)=3.83×10^{-5} *5*; α(Q)=2.146×10^{-6} *30*
592.5 *3*	33 *7*	4675.4		4082.9	$39/2^+$			A_2=−0.53 *4* (1986By01) The angular distribution is consistent with a dipole transition; the intensity balance at the 4675-keV level is worse if it is an E1 transition. α(E1)=0.00812, α(M1)=0.1038.
594.7 *4*	30 *6*	5814.8	$(45/2^+)$	5220.2				
621.8 *3*	18 *6*	6724.5	$55/2^+$	6102.7	$49/2^-$	[E3]	0.0681 *10*	A_2=+0.19 *14* (1986By01) α(K)=0.0384 *5*; α(L)=0.02205 *31*; α(M)=0.00580 *8* α(N)=0.001529 *22*; α(O)=0.000328 *5*; α(P)=4.70×10^{-5} *7*; α(Q)=1.171×10^{-6} *16*
624.2[@d] *5*		4653.6?		4029.2				
665[&d]		4695.9	$39/2^-$	4029.2				
681.3 *1*	439 *15*	2537.61	$29/2^+$	1856.30	$23/2^-$	E3	0.0529 *7*	A_2=+0.20 *1*; A_4=+0.02 *1* (1986By01) α(K)=0.0317 *4*; α(L)=0.01579 *22*; α(M)=0.00412 *6* α(N)=0.001086 *15*; α(O)=0.0002336 *33*; α(P)=3.38×10^{-5} *5*; α(Q)=9.27×10^{-7} *13* Mult.: α(K)exp=0.046 *5*, α(L)exp=0.018 *2*, and α(M)exp=0.007 *1* (1986By01).
695[&]		7983.6	$61/2^-$	7288.0	$57/2^+$			
738.8[‡] *3*	16.8 *20*	7541.8	(57/2)	6803.0	(55/2)	D		A_2=−0.33 *10* (1986By01)

$^{213}_{87}Fr_{126}$-6

$^{213}_{87}Fr_{126}$-7

γ(^{213}Fr) (continued)

E_γ [†]	I_γ [a]	E_i(level)	J^π_i	E_f	J^π_f	Mult. [b]	α [c]	Comments
								Mult.: The angular distribution is consistent with dipole character for this transition. α(E1)=0.00532, α(M1)=0.0580.
758.0[‡] 4	34 7	6572.9	49/2$^+$	5814.8	(45/2$^+$)			A_2=+0.26 15; A_4=−0.15 21 (1986By01)
784.0 4	6 2	5785.9	47/2$^-$	5001.9				
786.9 1	214 20	6572.9	49/2$^+$	5785.9	47/2$^-$	E1	0.00473 7	A_2=−0.292 53; A_4=+0.020 82 (1979Ho06) A_2=−0.21 2; A_4=+0.02 3 (1986By01) α(K)=0.00390 5; α(L)=0.000635 9; α(M)=0.0001491 21 α(N)=3.89×10^{-5} 5; α(O)=8.63×10^{-6} 12; α(P)=1.363×10^{-6} 19; α(Q)=7.27×10^{-8} 10 Mult.: From α(K)exp=0.007 2 (1986By01).
793.2 3	254 40	5785.9	47/2$^-$	4992.7	45/2$^-$	M1	0.0481	A_2=−0.212 78; A_4=+0.048 120 (1979Ho06) A_2=−0.067 15; A_4=+0.04 2 (1986By01) α(K)=0.0391 6; α(L)=0.00690 10; α(M)=0.001638 23 α(N)=0.000429 6; α(O)=9.60×10^{-5} 14; α(P)=1.541×10^{-5} 22; α(Q)=8.66×10^{-7} 13 Mult.,δ: α(K)exp=0.041 7, α(L)exp=0.0097 10 (1986By01), pol=−0.52 36 (1979Ho06). δ=0.00 19 using the α(K)exp and α(L)exp data.
810.2 3	144 8	5506.3	43/2$^-$	4695.9	39/2$^-$	E2	0.01293 18	A_2=+0.23 2; A_4=+0.03 4 (1986By01) α(K)=0.00975 14; α(L)=0.002392 34; α(M)=0.000590 8 α(N)=0.0001545 22; α(O)=3.38×10^{-5} 5; α(P)=5.12×10^{-6} 7; α(Q)=2.112×10^{-7} 30 Mult.: α(K)exp=0.0065 35 (1986By01).
815.6 2	157 9	4898.5	41/2$^-$	4082.9	39/2$^+$	E1	0.00443 6	A_2=−0.229 18; A_4=+0.002 26 (1979Ho06) A_2=−0.24 2; A_4=+0.09 3 (1986By01) α(K)=0.00365 5; α(L)=0.000593 8; α(M)=0.0001392 19 α(N)=3.63×10^{-5} 5; α(O)=8.06×10^{-6} 11; α(P)=1.274×10^{-6} 18; α(Q)=6.82×10^{-8} 10 Mult.: From α(K)exp=0.006 3 (1986By01), pol=0.35 15 (1979Ho06).
817.7 3	20 6	7541.8	(57/2)	6724.5	55/2$^+$			
884.0 3	31 5	2740.2	27/2$^-$	1856.30	23/2$^-$	E2	0.01087 15	A_2=+0.22 6 (1986By01) α(K)=0.00831 12; α(L)=0.001929 27; α(M)=0.000473 7 α(N)=0.0001238 17; α(O)=2.71×10^{-5} 4; α(P)=4.14×10^{-6} 6; α(Q)=1.787×10^{-7} 25 Mult.: From α(K)exp=0.015 6 (1986By01).
889.7 1	300 12	3427.34	33/2$^+$	2537.61	29/2$^+$	E2	0.01073 15	A_2=0.311 18; A_4=−0.085 29 (1979Ho06) A_2=+0.24 1; A_4=−0.02 2 (1986By01) α(K)=0.00822 12; α(L)=0.001899 27; α(M)=0.000465 7 α(N)=0.0001219 17; α(O)=2.67×10^{-5} 4; α(P)=4.08×10^{-6} 6; α(Q)=1.765×10^{-7} 25 Mult.: From α(K)exp=0.011 2, α(L)exp=0.002 1 (1986By01), pol=0.53 14 (1979Ho06).
909.8 2	116 9	4992.7	45/2$^-$	4082.9	39/2$^+$	E3	0.0255 4	A_2=0.538 37; A_4=+0.038 51 (1979Ho06) A_2=+0.43 3; A_4=+0.06 4 (1986By01)

From ENSDF

$^{213}_{87}Fr_{126}$-7

(HI,xnγ) (continued)

γ(^{213}Fr) (continued)

E_γ[†]	I_γ[a]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[b]	α[c]	Comments
								α(K)=0.01750 *25*; α(L)=0.00601 *8*; α(M)=0.001530 *21* α(N)=0.000403 *6*; α(O)=8.75×10^{-5} *12*; α(P)=1.303×10^{-5} *18*; α(Q)=4.59×10^{-7} *6* Mult.: From α(K)exp=0.023 *3*, α(L)exp=0.006 *1* (1986By01), pol=0.88 *22* (1979Ho06).
929.5 *3*	132 *26*	6715.3	53/2$^+$	5785.9	47/2$^-$	E3	0.02428 *34*	A_2=+0.46 *3*; A_4=+0.03 *5* (1986By01) α(K)=0.01676 *23*; α(L)=0.00563 *8*; α(M)=0.001429 *20* α(N)=0.000376 *5*; α(O)=8.18×10^{-5} *11*; α(P)=1.221×10^{-5} *17*; α(Q)=4.37×10^{-7} *6* Mult.: From α(K)exp=0.014 *8*, α(L)exp=0.0045 *15* (1986By01).
949.4[‡] *3*	10 *4*	5951.5		5001.9				A_2=−0.03 *13* (1986By01)
959.0[‡] *3*	11 *3*	5951.5		4992.7	45/2$^-$			A_2=+0.23 *14* (1986By01)
^{x}963.4[@] *5*								
998.9 *3*	12 *4*	7723.7	59/2$^+$	6724.5	55/2$^+$			
1040.3 *3*	111 *11*	4695.9	39/2$^-$	3655.4	37/2$^+$	E1	0.00286 *4*	A_2=−0.27 *3*; A_4=+0.04 *4* (1986By01) α(K)=0.002364 *33*; α(L)=0.000377 *5*; α(M)=8.83×10^{-5} *12* α(N)=2.304×10^{-5} *32*; α(O)=5.13×10^{-6} *7*; α(P)=8.15×10^{-7} *11*; α(Q)=4.46×10^{-8} *6* Mult.: From α(K)exp=0.0017 *6* (1986By01).
1188.8 *1*	1000 *40*	1188.80	13/2$^-$	0.0	9/2$^-$	E2	0.00616 *9*	A_2=+0.041 *6*; A_4=−0.01 *1* (1986By01) α(K)=0.00487 *7*; α(L)=0.000976 *14*; α(M)=0.0002354 *33* α(N)=6.16×10^{-5} *9*; α(O)=1.360×10^{-5} *19*; α(P)=2.119×10^{-6} *30*; α(Q)=1.025×10^{-7} *14* α(IPF)=2.65×10^{-6} *4* Mult.: From α(K)exp=0.0053 *6*, α(L)exp=0.00097 *10* (1986By01).
1259.1 *3*	254 *12*	7983.6	61/2$^-$	6724.5	55/2$^+$	E3	0.01229 *17*	A_2=+0.15 *4*; A_4=+0.00 *6* (1986By01) α(K)=0.00916 *13*; α(L)=0.002352 *33*; α(M)=0.000583 *8* α(N)=0.0001532 *21*; α(O)=3.36×10^{-5} *5*; α(P)=5.15×10^{-6} *7*; α(Q)=2.204×10^{-7} *31* α(IPF)=3.31×10^{-6} *5* Mult.: From α(K)exp=0.010 *2* (1986By01).

[†] From 1991ByZZ, except where otherwise noted. See also 1989By01, 1986By01, 1976Ha37, 1977Be56. Other measurements: 1971MaXH, 1974Re09.

[‡] Eγ placement from 1989By01.

[#] Transition was not observed; energy from decay scheme.

[@] From 1986By01, not listed by 1991ByZZ.

[&] From level scheme shown in 1989By01; transition was not listed by 1991ByZZ and 1986By01.

[a] Relative photon intensities, measured by 1991ByZZ in a time window 2-9 microseconds after the beam burst. Therefore, these Iγ's represent relative feedings

$^{213}_{87}Fr_{126}$-8

$\gamma(^{213}Fr)$ (continued)

through the 4.5−μs isomer at 8095 keV. See also 1986By01.

[b] From conversion electron measurements and angular distribution of the γ-ray (1986By01), except otherwise noted.

[c] Additional information 1.

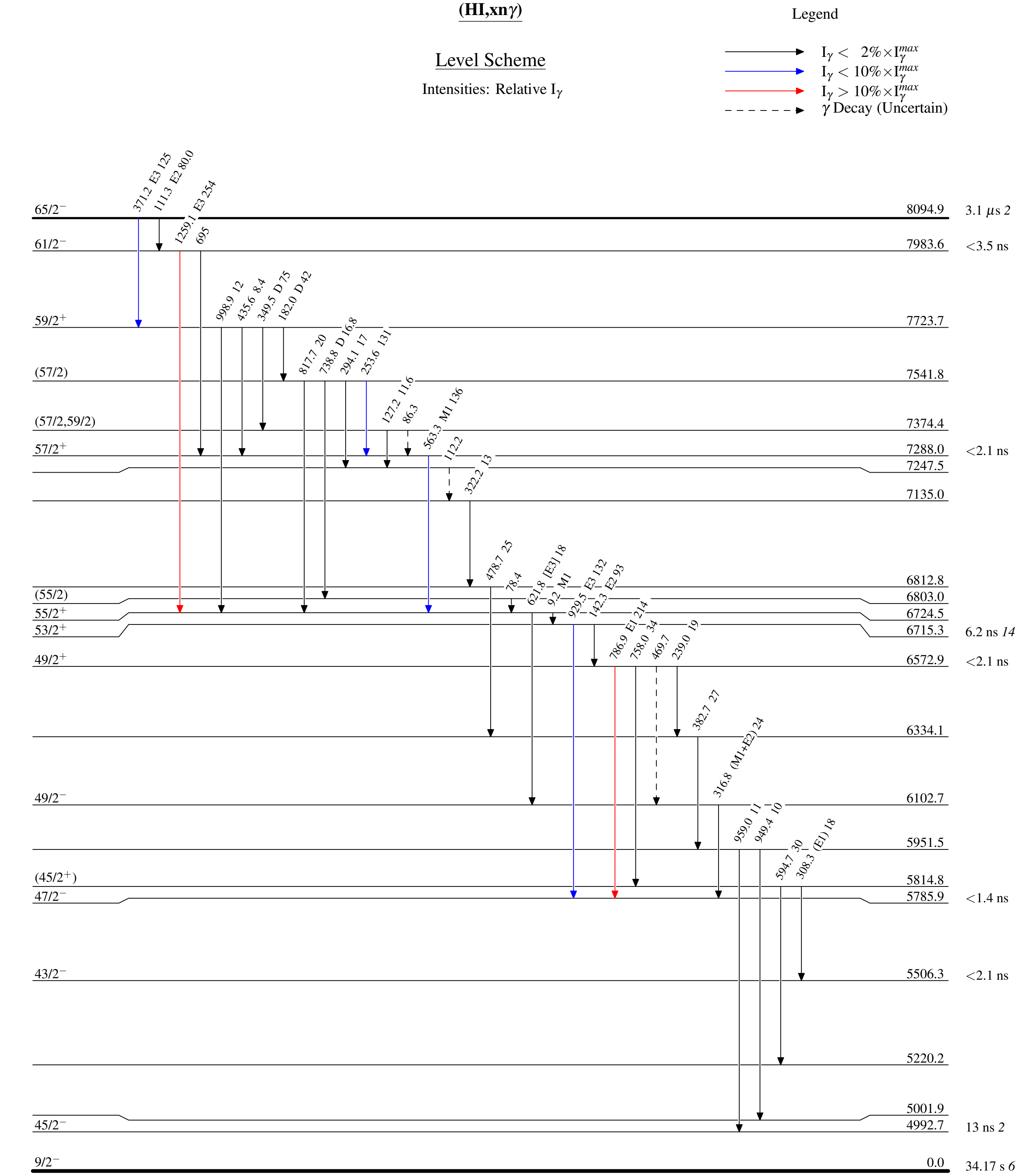
[d] Placement of transition in the level scheme is uncertain.

[x] γ ray not placed in level scheme.

(HI,xnγ)

Level Scheme

Intensities: Relative I_γ



$^{213}_{87}Fr_{126}$

(HI,xnγ)

Level Scheme (continued)

Intensities: Relative I_γ