

Adopted Levels, Gammas

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	S. -c. Wu	NDS 108,1057 (2007)	1-Mar-2007

$Q(\beta^-) = -320$ 10; $S(n) = 5418$ 8; $S(p) = 3149$ 9; $Q(\alpha) = 9174$ 4 [2012Wa38](#)

Note: Current evaluation has used the following Q record -312 17 5411 16 3141 16 9175 12 [2003Au03](#).

 ^{216}Fr Levels

Calculated n-p interaction energy ([1990Mo11](#)).

Cross Reference (XREF) Flags

A ^{220}Ac α decay
B $^{208}\text{Pb}(^{11}\text{B}, 3n\gamma)$

E(level) [†]	J π [‡]	T _{1/2}	XREF	Comments
0	(1 ⁻)	0.70 μs 2	A	$\% \alpha = 100$; $\% \epsilon < 2 \times 10^{-7}$ syst J π : HF=1.3 to (1 ⁻). T _{1/2} : from 1970Bo13 . $\% \alpha$: from gross β decay strength function estimate of 1973Ta30 , $\% \epsilon + \% \beta^+ < 2 \times 10^{-7}$. From $\log ft > 3.6$, $\% \epsilon + \% \beta^+ < 6 \times 10^{-6}$ for the g.s. branch, $< 4 \times 10^{-6}$ for the branch to the 465 level, and is smaller yet for decay to any single higher excited state.
133.3 1	(3 ⁻)	71 ns 5	A	$\% \alpha > 50$ J π : E2 γ to (1 ⁻). T _{1/2} : from 1971EpZY . $\% \alpha$: from ^{220}Ac α decay.
141.6 2	(0 ⁻ , 1 ⁻ , 2 ⁻)		A	J π : M1 γ to (1 ⁻) g.s.
191.2 2	(5 ⁻)		A	J π : E2 γ to (3 ⁻); no γ to (1 ⁻) g.s.
212.0 2			A	
226.1 2	(3 ⁻ , 4, 5 ⁻)		A	J π : γ 's to (3 ⁻) and (5 ⁻) levels.
247.8? 4			A	
249.4 2			A	
254.4 2	(1 ⁻ , 2, 3 ⁻)		A	J π : γ 's to (1 ⁻) and (3 ⁻) levels.
290.4 2			A	
344.2 2			A	
349.3 3			A	
409.3 2			A	
493.4 2			A	
532.1 2			A	
539.4 4			A	
550.9 2			A	
568.8 4			A	
581.5 3	(3 ⁻ , 4, 5 ⁻)		A	J π : γ 's to (3 ⁻) and (5 ⁻) levels.
x [#]	(9 ⁻)		B	J π : from syst.
527.70+x [#] 20	(11 ⁻)		B	
762.6+x [@] 3	(12 ⁺)		B	
969.4+x [#] 3	(13 ⁻)		B	
1261.1+x [@] 3	(14 ⁺)		B	
1383.2+x [#] 3	(15 ⁻)		B	
1659.9+x [@] 4	(16 ⁺)		B	

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Adopted Levels, Gammas (continued) ^{216}Fr Levels (continued)

<u>E(level)[†]</u>	<u>J^π[‡]</u>	<u>XREF</u>
1834.8+x [#] 4	(17 ⁻)	B
1973.0+x [@] 4	(18 ⁺)	B

[†] From least squares fit to E_γ .

[‡] Arguments for J^π assignment for levels seen in α decay are given. For additional J^π assignments based on proposed configurations, see ^{220}Ac α decay data set. The J^π for levels seen in ($^{11}\text{B}, 3n\gamma$) reaction are based on E1 and E2 character of deexciting transitions, band structure, unless otherwise noted. Although the relative J and π for these levels are well established, $J^\pi=(9^-)$ for the bandhead is based on syst.

[#] Band(A): $\pi=-$ band.

[@] Band(B): $\pi=+$ band.

 $\gamma(^{216}\text{Fr})$

The data for γ 's from levels with known E(level) are from ^{220}Ac α decay; the data for γ 's from bands built on the (9⁻) level are from $^{208}\text{Pb}(^{11}\text{B}, 3n\gamma)$.

<u>$E_i(\text{level})$</u>	<u>J^π_i</u>	<u>E_γ</u>	<u>I_γ</u>	<u>E_f</u>	<u>J^π_f</u>	<u>Mult.</u>	<u>α[†]</u>	<u>Comments</u>
133.3	(3 ⁻)	133.3 1	100	0	(1 ⁻)	E2	2.65	B(E2)(W.u.)=0.67 5
141.6	(0 ⁻ , 1 ⁻ , 2 ⁻)	141.6 2	100	0	(1 ⁻)	M1	5.32	
191.2	(5 ⁻)	57.9 1	100	133.3	(3 ⁻)	E2	118.3 20	
212.0		78.6 2	100	133.3	(3 ⁻)			
226.1	(3 ⁻ , 4, 5 ⁻)	34.9 3	≈5	191.2	(5 ⁻)	(M1)	61.5 18	
		92.8 1	100 14	133.3	(3 ⁻)	M1	3.50	
247.8?		247.8 [‡] 4	100	0	(1 ⁻)			
249.4		37.4 3	100	212.0				
254.4	(1 ⁻ , 2, 3 ⁻)	42.5 [‡] 2	≈38	212.0				
		121.0 2	100 18	133.3	(3 ⁻)			
		254.4 5	68 21	0	(1 ⁻)			
290.4		64.3 1	100	226.1	(3 ⁻ , 4, 5 ⁻)			
344.2		53.6 2	≈12	290.4				
		94.8 1	100 16	249.4				
		118.2 2	54 14	226.1	(3 ⁻ , 4, 5 ⁻)	(M1)	8.90	
		153.1 2	73 14	191.2	(5 ⁻)			
349.3		137.3 2	100	212.0				
409.3		160.0 1	100	249.4		M1	3.76	
493.4		149.0 3	53 16	344.2				
		203.6 5	≈17	290.4				
		243.7 2	100 22	249.4		M1	1.156	
		267.8 3	100 22	226.1	(3 ⁻ , 4, 5 ⁻)	M1	0.890	
532.1		123.3 3	38 10	409.3				
		182.8 3	38 11	349.3				
		187.8 2	100 21	344.2				
		305.6 4	69 28	226.1	(3 ⁻ , 4, 5 ⁻)			
539.4		130.4 4	≈29	409.3				
		312.9 4	100 14	226.1	(3 ⁻ , 4, 5 ⁻)	(M1)	0.580	
550.9		206.7 2	60 15	344.2				
		296.4 3	100 25	254.4	(1 ⁻ , 2, 3 ⁻)	M1	0.673	
		301.4 3	65 20	249.4				
568.8		342.7 3	100 14	226.1	(3 ⁻ , 4, 5 ⁻)	M1	0.452	
		378.0 10	≈6	191.2	(5 ⁻)			

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Adopted Levels, Gammas (continued) $\gamma(^{216}\text{Fr})$ (continued)

$E_i(\text{level})$	J_i^π	E_γ	I_γ	E_f	J_f^π	Mult.	$\alpha^\dagger$
581.5	(3 ⁻ ,4,5 ⁻)	172.2 3	76 20	409.3			
		390.2 5	100 38	191.2	(5 ⁻)		
		448.4 10	≈30	133.3	(3 ⁻)		
527.70+x	(11 ⁻)	527.7 2	100	x	(9 ⁻)	E2	0.0325
762.6+x	(12 ⁺)	235.0 2	100	527.70+x	(11 ⁻)	E1	0.0601
969.4+x	(13 ⁻)	206.7 2	12.2 11	762.6+x	(12 ⁺)	E1	0.0815
		441.6 2	100 11	527.70+x	(11 ⁻)	E2	0.0499
1261.1+x	(14 ⁺)	291.5 2	26.3 17	969.4+x	(13 ⁻)	E1	0.0365
		498.6 2	100 12	762.6+x	(12 ⁺)	E2	0.0371
1383.2+x	(15 ⁻)	121.9 2	4.9 9	1261.1+x	(14 ⁺)	E1	0.293
		414.0 2	100 9	969.4+x	(13 ⁻)	E2	0.0588
1659.9+x	(16 ⁺)	276.8 2	100 10	1383.2+x	(15 ⁻)	E1	0.0411
		398.9 2	38 4	1261.1+x	(14 ⁺)	E2	0.0648
1834.8+x	(17 ⁻)	175.2 2	95 10	1659.9+x	(16 ⁺)	E1	0.1212
		451.3 2	100 15	1383.2+x	(15 ⁻)	[E2]	0.0473
1973.0+x	(18 ⁺)	138.2 2	23 7	1834.8+x	(17 ⁻)	E1	0.216
		313.0 2	100 11	1659.9+x	(16 ⁺)	E2	0.1276

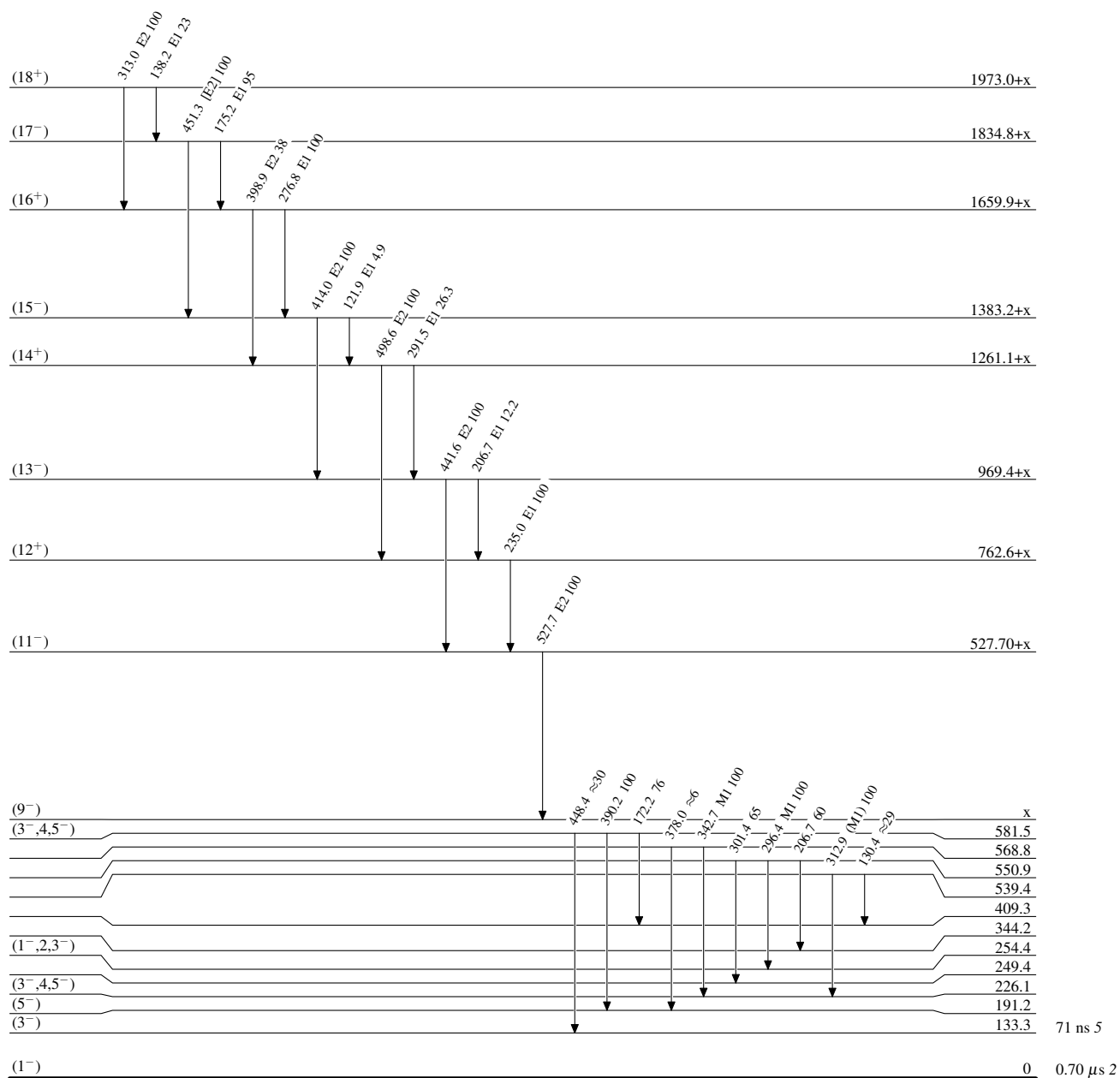
[†] Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ -ray energies, assigned multiplicities, and mixing ratios, unless otherwise specified.

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

Adopted Levels, Gammas

Level Scheme

Intensities: Relative photon branching from each level



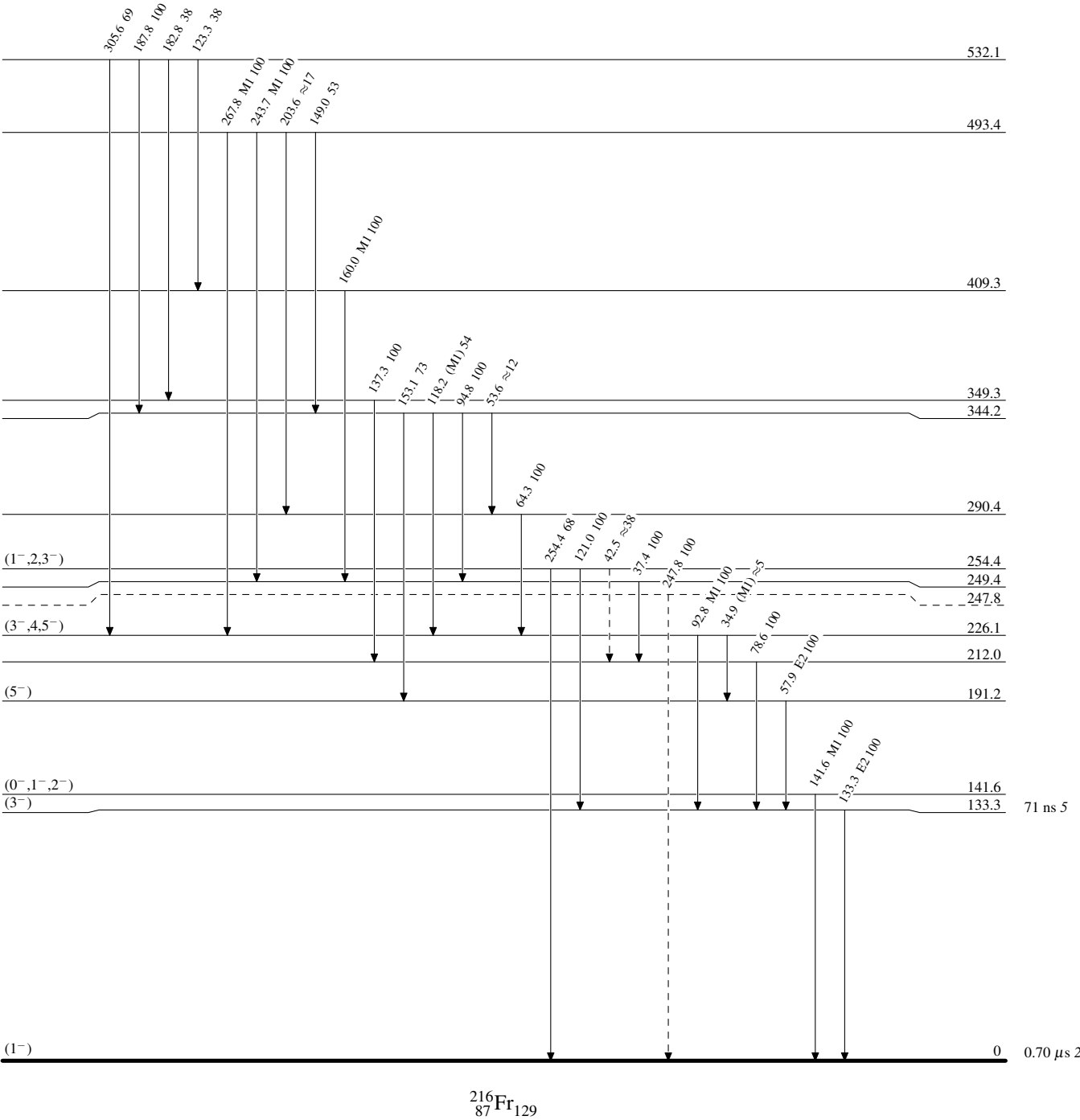
Adopted Levels, Gammas

Legend

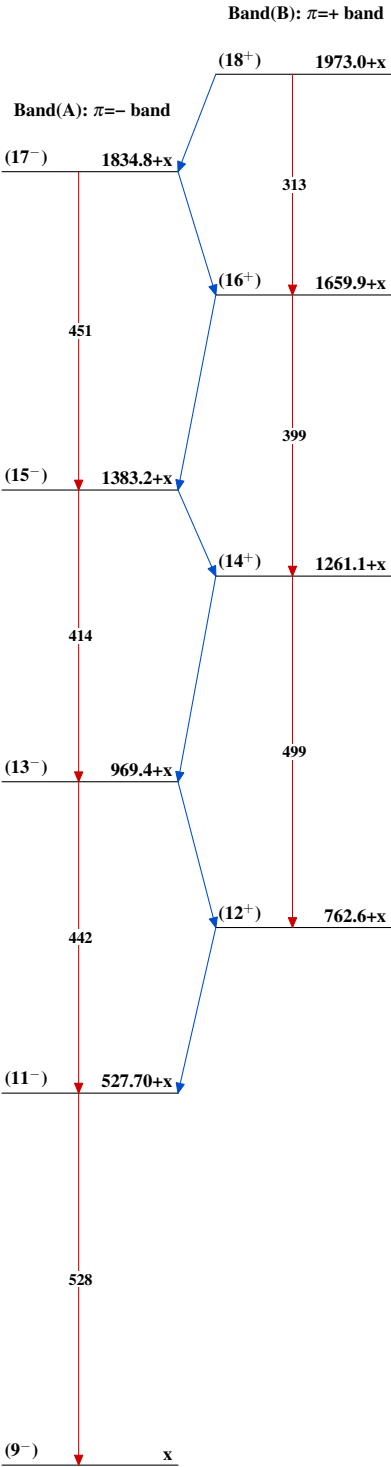
Level Scheme (continued)

Intensities: Relative photon branching from each level

-----► γ Decay (Uncertain)



Adopted Levels, Gammas



$^{216}_{87}\text{Fr}_{129}$