

**Adopted Levels, Gammas**

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh	NDS 141, 327 (2017)	22-Mar-2017

$Q(\beta^-) = -1970$  SY;  $S(n) = 6384$  7;  $S(p) = 5891$  12;  $Q(\alpha) = 7027$  5    [2017Wa10](#)

Estimated uncertainty=120 for  $Q(\beta^-)$  ([2017Wa10](#)).

$S(2n) = 11559$  7,  $S(2p) = 10433$  12 ([2017Wa10](#)).

[1955Ch30](#) produced and identified  $^{256}\text{Fm}$  in neutron irradiation of  $^{255}\text{Es}$ , and  $\beta^-$  decay of  $^{256}\text{Es}$  at Berkeley. Measured half-life from decay curve for spontaneous fission. Later studies: of  $^{256}\text{Fm}$  decay: [1958Ph40](#), [1965Si14](#), [1968Ho13](#), [1972Fl04](#), [1981Lo15](#).

Theoretical calculations: consult the Nuclear Science References (NSR) database for about 200 theory references.

[2014Sh07](#), [2013Af01](#), [2013Pr08](#), [2012Jo05](#): nuclear structure theory references.

 **$^{256}\text{Fm}$  Levels**

Assignments to band members are from depopulation patterns, and energy fit to rotational bands.

**Cross Reference (XREF) Flags**

- A**  $^{256}\text{Es}$   $\beta^-$  decay (25.4 min)
- B**  $^{256}\text{Es}$   $\beta^-$  decay (7.6 h)
- C**  $^{256}\text{Md}$   $\varepsilon$  decay (77.7 min)

E(level) <sup>†</sup>	J <sup>π</sup>	T <sub>1/2</sub>	XREF	Comments
0.0 <sup>#</sup>	0 <sup>+</sup>	157.1 min 13	<a href="#">BC</a>	% $\alpha$ =8.1 3; %SF=91.9 3 $T_{1/2}$ : weighted average of 150 min 4 ( <a href="#">1981Lo15</a> ), 157.6 min 13 ( <a href="#">1972Fl04</a> ), 157 min 2 ( <a href="#">1968Ho13</a> ), 162 min 6 ( <a href="#">1965Si14</a> ), 160 min 10 ( <a href="#">1958Ph40</a> ). Other: $\approx$ 3-4 h ( <a href="#">1955Ch30</a> ). Branching: $a/(a+SF)=0.081$ 3 was determined by <a href="#">1968Ho13</a> from $\alpha$ and SF counts. Other measurement: SF/ $\alpha$ =35 10 ( <a href="#">1965Si14</a> ). Emission of $\alpha$ rays, tritons and protons in the SF of $^{256}\text{Fm}$ was studied by <a href="#">1985Wi10</a> .
48.12 <sup>#</sup> 16	2 <sup>±‡</sup>		<a href="#">BC</a>	
159.60 <sup>#</sup> 20	4 <sup>±‡</sup>		<a href="#">BC</a>	
332.2 <sup>#</sup> 3	6 <sup>±‡</sup>		<a href="#">B</a>	
563.3 <sup>#</sup> 3	8 <sup>±‡</sup>		<a href="#">B</a>	
682.21 <sup>@</sup> 14	(2 <sup>+</sup> )		<a href="#">BC</a>	$J^\pi$ : relative photon intensities of transitions to 0 <sup>+</sup> and 2 <sup>+</sup> states of g.s. band suggest $J^\pi=2^+$ .
725.43 <sup>@</sup> 19	(3 <sup>+</sup> )		<a href="#">BC</a>	
783.20 <sup>@</sup> 22	(4 <sup>+</sup> )		<a href="#">B</a>	
853.4 <sup>@</sup> 5	(5 <sup>+</sup> )		<a href="#">B</a>	
881.59 <sup>&amp;</sup> 19	(2 <sup>-</sup> )		<a href="#">B</a>	$J^\pi$ : $\gamma$ transitions to the (2 <sup>+</sup> ),(3 <sup>+</sup> ) states of K=2 $\gamma$ -vibrational band, and $\gamma$ to only 2 <sup>+</sup> of the K=0 g.s. band; no $\gamma$ rays to 0 <sup>+</sup> ,4 <sup>+</sup> of the K=0 g.s. band.
922.03 <sup>&amp;</sup> 23	(3 <sup>-</sup> )		<a href="#">B</a>	
938.8 <sup>@</sup> 16	(6 <sup>+</sup> )		<a href="#">B</a>	
978.1 <sup>&amp;</sup> 5	(4 <sup>-</sup> )		<a href="#">B</a>	
1039.0 <sup>@</sup> 4	(7 <sup>+</sup> )		<a href="#">B</a>	
1045.1 <sup>&amp;</sup> 5	(5 <sup>-</sup> )		<a href="#">B</a>	
1099.73 <sup>a</sup> 18	(3 <sup>+</sup> )		<a href="#">B</a>	$J^\pi$ : $\gamma$ transitions to 2 <sup>+</sup> , (2 <sup>-</sup> ) and 4 <sup>+</sup> state rule out J<2, 2 <sup>-</sup> , J>3 for 1099.7 level; 218.1 $\gamma$ to (2 <sup>-</sup> ) might be E1, as deduced from intensity balance at the 882.8 level in 7.6-h $^{256}\text{Es}$ $\beta^-$ decay. The probable $J^\pi$ values, then, are 2 <sup>+</sup> and 3 <sup>+</sup> . From the

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**Adopted Levels, Gammas (continued)** **$^{256}\text{Fm}$  Levels (continued)**

E(level) <sup>†</sup>	J <sup>π</sup>	T <sub>1/2</sub>	XREF	Comments
1123.0 <sup>&amp;</sup> 5	(6 <sup>-</sup> )		B	branching ratios of deexciting gammas, <a href="#">1989Ha10</a> suggested J <sup>π</sup> =3 <sup>+</sup> which is consistent with absence of γ to the 0 <sup>+</sup> g.s.
1150.3? <sup>@</sup>	(8 <sup>+</sup> )		B	
1150.4 <sup>a</sup> 4	(4 <sup>+</sup> )		B	
1213.5? <sup>&amp;</sup> 11	(7 <sup>-</sup> )		B	
1251.6 <sup>b</sup> 4	(5 <sup>+</sup> )		B	J <sup>π</sup> : γ transitions to (3 <sup>+</sup> ) and (4 <sup>+</sup> ) states of K=2 band, but no γ to 2 <sup>+</sup> bandhead imply J <sup>π</sup> of 5 <sup>+</sup> for the 1251.6 level.
1326.17 18	(1 <sup>+</sup> )		C	Proposed configuration= $\nu 7/2[613] \otimes \nu 9/2[615]$ ( <a href="#">2000Ah02</a> ).
1328.3? <sup>b</sup> 4	(6 <sup>+</sup> )		B	J <sup>π</sup> : from probable (E1) character of the 96.8γ from (7 <sup>-</sup> ) isomeric state.
1360.4 3	(2 <sup>+</sup> )		C	Proposed configuration= $\nu 7/2[613] \otimes \nu 9/2[615]$ ( <a href="#">2000Ah02</a> ).
1374.19 18	(1 <sup>-</sup> )		C	Proposed configuration= $\pi 7/2[633] \otimes \pi 7/2[514]$ ( <a href="#">2000Ah02</a> ).
1405.27 21	(2 <sup>-</sup> )		C	Proposed configuration= $\pi 7/2[633] \otimes \pi 7/2[514]$ ( <a href="#">2000Ah02</a> ).
1425.1 3	(7 <sup>-</sup> )	70 ns 5	B	%IT=100
1559.8 4	(7 <sup>+,8<sup>+</sup>)</sup>		B	T <sub>1/2</sub> : from <a href="#">1989Ha10</a> by (β)(231γ)(t) data. The observed β-delayed fission activities were consistent with this half-life. The partial half-life for fission was deduced by <a href="#">1989Ha10</a> as 0.8 ms +88–7 from the β-delayed-fission probability of $2 \times 10^{-5}$ (measured number of delayed fissions/total number of β <sup>-</sup> decays of 7.6-h $^{256}\text{Es}$ ; two fission events were observed.). J <sup>π</sup> : γ transitions to 8 <sup>+</sup> and (5 <sup>-</sup> ) states, relative photon intensities of deexciting γ rays, and nonobservation of transitions to 5 <sup>+</sup> , 4 <sup>+</sup> states suggest J <sup>π</sup> =(7 <sup>-</sup> ). <a href="#">1989Ha10</a> pointed out that this level could be analogous to the 7 <sup>-</sup> ,two-quasiparticle state predicted for $^{254}\text{Fm}$ by <a href="#">1964So02</a> : K <sup>π</sup> =7 <sup>-</sup> , π7/2[633]⊗π7/2[514].
				J <sup>π</sup> : log ft for the β branch from 7.6-h $^{256}\text{Es}$ indicates an allowed transition, if completion of the decay scheme would not decrease β intensity considerably. If J <sup>π</sup> (7.6-h $^{256}\text{Es}$ parent)=8 <sup>+</sup> , then π(1560 level)=+. From γ transition to the (7 <sup>-</sup> ) state, J <sup>π</sup> =7 <sup>+</sup> or 8 <sup>+</sup> may be deduced. Because of the assumptions made, however, these suggested spins should be considered as very tentative.

<sup>†</sup> From least-squares fit to Eγ values.<sup>‡</sup> Strong evidence for the presence of rotational band based on g.s.<sup>#</sup> Band(A): K<sup>π</sup>=0<sup>+</sup> band.<sup>@</sup> Band(B): K<sup>π</sup>=(2<sup>+</sup>) γ-vibrational band.<sup>&</sup> Band(C): K<sup>π</sup>=(2<sup>-</sup>) octupole-vibrational band.<sup>a</sup> Band(D): K<sup>π</sup>=(3<sup>+</sup>) band.<sup>b</sup> Band(E): K<sup>π</sup>=(5<sup>+</sup>) band. **$\gamma(^{256}\text{Fm})$** 

E <sub>i</sub> (level)	J <sup>π</sup> <sub>i</sub>	E <sub>γ</sub> <sup>†</sup>	I <sub>γ</sub> <sup>†</sup>	E <sub>f</sub>	J <sup>π</sup> <sub>f</sub>	Mult.	α <sup>#</sup>	I <sub>(γ+ce)</sub>
48.12	2 <sup>+</sup>	(48.3 <sup>‡</sup> 3)		0.0	0 <sup>+</sup>	[E2]	832	100
159.60	4 <sup>+</sup>	111.6 2	100	48.12	2 <sup>+</sup>	[E2]	15.96	
332.2	6 <sup>+</sup>	172.6 2	100	159.60	4 <sup>+</sup>	[E2]	2.40	
563.3	8 <sup>+</sup>	231.1 2	100	332.2	6 <sup>+</sup>	[E2]	0.772	
682.21	(2 <sup>+</sup> )	634.1 <sup>a</sup> 2	94 <sup>a</sup> 10	48.12	2 <sup>+</sup>			
		682.2 2	100	0.0	0 <sup>+</sup>			
725.43	(3 <sup>+</sup> )	565.9 3	23 4	159.60	4 <sup>+</sup>			
		677.4 2	100 8	48.12	2 <sup>+</sup>			
783.20	(4 <sup>+</sup> )	450.8 15	13	332.2	6 <sup>+</sup>			

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**Adopted Levels, Gammas (continued)** $\gamma(^{256}\text{Fm})$  (continued)

E <sub>i</sub> (level)	J <sup>π</sup> <sub>i</sub>	E <sub>γ</sub> <sup>†</sup>	I <sub>γ</sub> <sup>†</sup>	E <sub>f</sub>	J <sup>π</sup> <sub>f</sub>
783.20	(4 <sup>+</sup> )	623.5 2	100	159.60	4 <sup>+</sup>
853.4	(5 <sup>+</sup> )	693.8 15	100	159.60	4 <sup>+</sup>
881.59	(2 <sup>-</sup> )	156 2	1.5	725.43	(3 <sup>+</sup> )
		199.3 2	26	682.21	(2 <sup>+</sup> )
		833.5 2	100	48.12	2 <sup>+</sup>
922.03	(3 <sup>-</sup> )	141 2	4	783.20	(4 <sup>+</sup> )
		197.4 <sup>b</sup> 5	35	725.43	(3 <sup>+</sup> )
		762.7 2	100	159.60	4 <sup>+</sup>
938.8	(6 <sup>+</sup> )	606.6 15	100	332.2	6 <sup>+</sup>
978.1	(4 <sup>-</sup> )	252.7 5	100	725.43	(3 <sup>+</sup> )
1039.0	(7 <sup>+</sup> )	185.7 5	22	853.4	(5 <sup>+</sup> )
		706.8 2	100	332.2	6 <sup>+</sup>
1045.1	(5 <sup>-</sup> )	(67.0 <sup>‡</sup> )		978.1	(4 <sup>-</sup> )
		192 2		853.4	(5 <sup>+</sup> )
1099.73	(3 <sup>+</sup> )	178.0 <sup>@</sup> 2	≤19	922.03	(3 <sup>-</sup> )
		218.1 2	100	881.59	(2 <sup>-</sup> )
		316.4 2	18	783.20	(4 <sup>+</sup> )
		374.2 2	25	725.43	(3 <sup>+</sup> )
		417.6 2	27	682.21	(2 <sup>+</sup> )
		940.1 15	14	159.60	4 <sup>+</sup>
		1051.5 2	45	48.12	2 <sup>+</sup>
1123.0	(6 <sup>-</sup> )	(78.0 <sup>‡</sup> )		1045.1	(5 <sup>-</sup> )
		269.5 5		853.4	(5 <sup>+</sup> )
1150.3?	(8 <sup>+</sup> )	211.2 <sup>@b</sup> 5		938.8	(6 <sup>+</sup> )
		586.6 <sup>b</sup> 15		563.3	8 <sup>+</sup>
1150.4	(4 <sup>+</sup> )	(50.8 <sup>‡</sup> )		1099.73	(3 <sup>+</sup> )
1213.5?	(7 <sup>-</sup> )	(90.5 <sup>‡</sup> )		1123.0	(6 <sup>-</sup> )
1251.6	(5 <sup>+</sup> )	397.2 <sup>b</sup> 5	82	853.4	(5 <sup>+</sup> )
		468.4 5	100	783.20	(4 <sup>+</sup> )
		526.1 5	91	725.43	(3 <sup>+</sup> )
1326.17	(1 <sup>+</sup> )	600.8 4	17 3	725.43	(3 <sup>+</sup> )
		644.0 2	100 8	682.21	(2 <sup>+</sup> )
		1278.0 3	14 2	48.12	2 <sup>+</sup>
		1326.1 <sup>&amp;</sup> 3	33 <sup>&amp;</sup> 3	0.0	0 <sup>+</sup>
1328.3?	(6 <sup>+</sup> )	(76.8 <sup>‡</sup> )		1251.6	(5 <sup>+</sup> )
		178.0 <sup>@</sup> 2		1150.4	(4 <sup>+</sup> )
1360.4	(2 <sup>+</sup> )	634.1 <sup>ab</sup> 2	76 <sup>a</sup> 30	725.43	(3 <sup>+</sup> )
		677.3 <sup>ab</sup> 2	<sup>a</sup>	682.21	(2 <sup>+</sup> )
		1200.6 5	42 9	159.60	4 <sup>+</sup>
		1312.3 3	100 9	48.12	2 <sup>+</sup>
1374.19	(1 <sup>-</sup> )	692.0 2	100 8	682.21	(2 <sup>+</sup> )
		1326.1 <sup>&amp;</sup> 3	49 <sup>&amp;</sup> 4	48.12	2 <sup>+</sup>
		1374.1 3	52 6	0.0	0 <sup>+</sup>
1405.27	(2 <sup>-</sup> )	680.0 3	70 6	725.43	(3 <sup>+</sup> )
		723.0 2	82 9	682.21	(2 <sup>+</sup> )
		1357.1 3	100 9	48.12	2 <sup>+</sup>
1425.1	(7 <sup>-</sup> )	96.8 2	13	1328.3?	(6 <sup>+</sup> )
		211.2 <sup>@b</sup> 5	≤4.4	1213.5?	(7 <sup>-</sup> )
		275.3 <sup>b</sup> 2	5.8	1150.3?	(8 <sup>+</sup> )
		302.0 5	4.2	1123.0	(6 <sup>-</sup> )
		380.0 5	1.9	1045.1	(5 <sup>-</sup> )

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**Adopted Levels, Gammas (continued)** $\gamma(^{256}\text{Fm})$  (continued)

$E_i$ (level)	$J_i^\pi$	$E_\gamma^\dagger$	$I_\gamma^\dagger$	$E_f$	$J_f^\pi$	Mult.	$\alpha^\#$
1425.1	(7 <sup>-</sup> )	861.8 2	100	563.3	8 <sup>+</sup>		
		1092.9 2	47	332.2	6 <sup>+</sup>		

1559.8 (7<sup>+,8<sup>+</sup></sup>) 134.7 2 100 1425.1 (7<sup>-</sup>) [E1] 0.0735

<sup>†</sup> From 7.6-h  $^{256}\text{Es}$   $\beta^-$  decay or  $^{256}\text{Md}$   $\varepsilon$  decay, when independent levels are populated in each. For 682 and 725 levels, populated in both the decays, unweighted averages are taken.

<sup>‡</sup> Transition has not been observed; its energy is from level scheme.

<sup>#</sup> Theoretical values from BrIcc code ([2008Ki07](#)) using “Frozen orbital” approximation.

<sup>@</sup> Multiply placed.

<sup>&</sup> Multiply placed with undivided intensity.

<sup>a</sup> Multiply placed with intensity suitably divided.

<sup>b</sup> Placement of transition in the level scheme is uncertain.

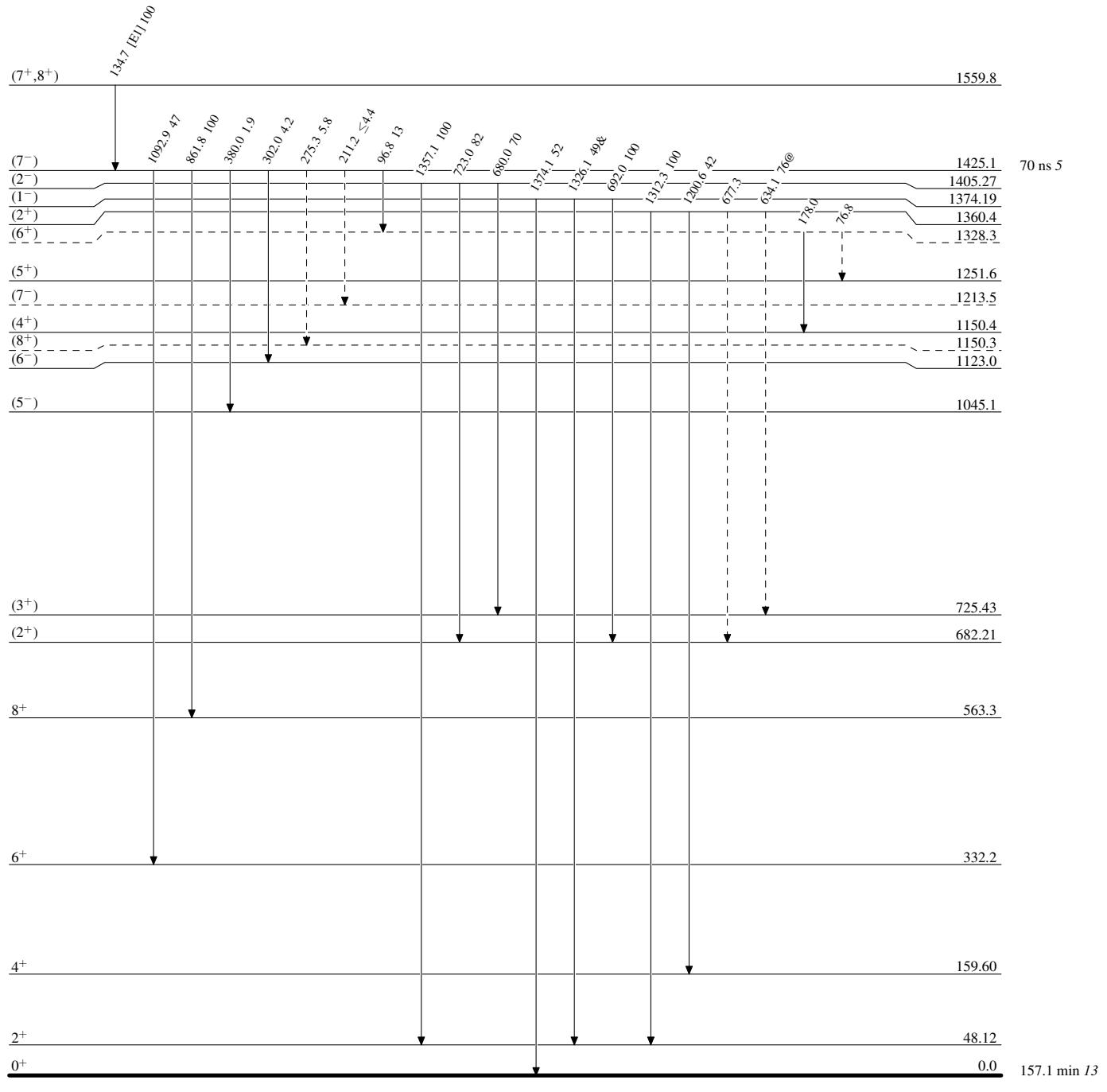
## Adopted Levels, Gammas

Level Scheme

## Legend

- Intensities: Relative photon branching from each level
- & Multiply placed: undivided intensity given
- @ Multiply placed: intensity suitably divided

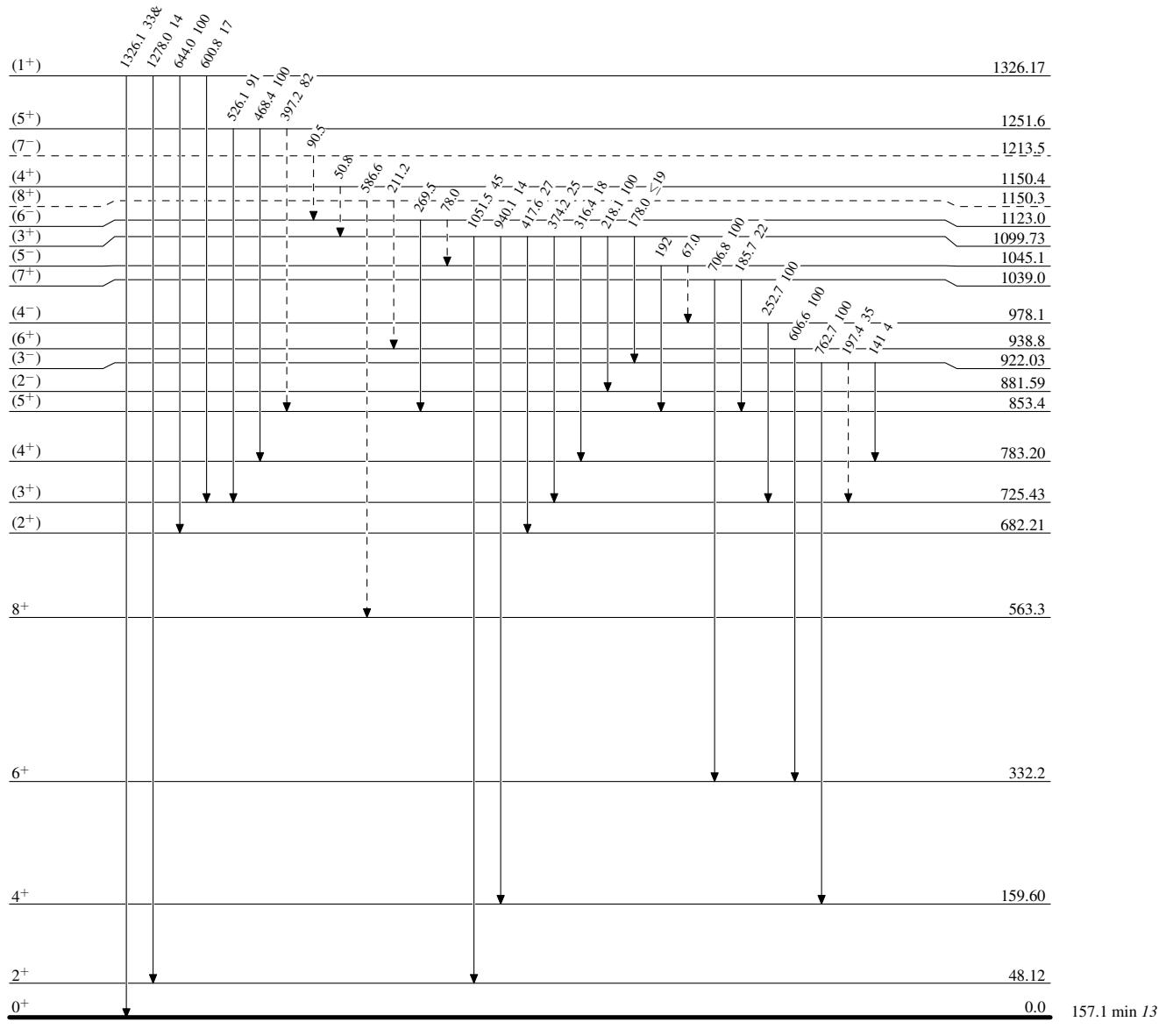
→  $\gamma$  Decay (Uncertain)



**Adopted Levels, Gammas****Level Scheme (continued)**

Legend

Intensities: Relative photon branching from each level  
 & Multiply placed: undivided intensity given  
 @ Multiply placed: intensity suitably divided



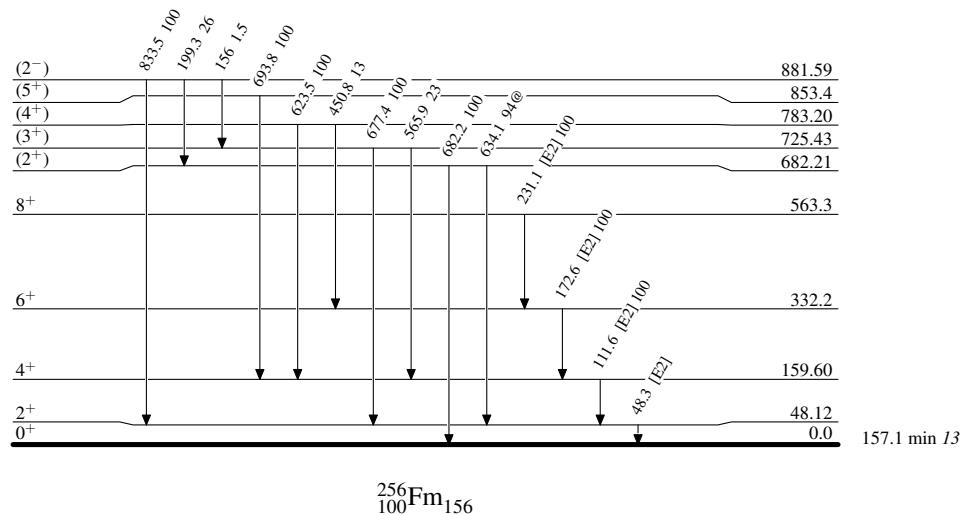
## Adopted Levels, Gammas

## Level Scheme (continued)

## Legend

- Intensities: Relative photon branching from each level
- & Multiply placed: undivided intensity given
- @ Multiply placed: intensity suitably divided

→  $\gamma$  Decay (Uncertain)



Adopted Levels, Gammas