Adopted Levels, Gammas

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

Q(β^-)=−1970 *SY*; S(n)=6384 *7*; S(p)=5891 *12*; Q(α)=7027 *5* 2017Wa10
Estimated uncertainty=120 for Q(β^-) (2017Wa10).
S(2n)=11559 *7*, S(2p)=10433 *12* (2017Wa10).
1955Ch30 produced and identified ^{256}Fm in neutron irradiation of ^{255}Es, and β^- decay of ^{256}Es at Berkeley. Measured half-life from decay curve for spontaneous fission. Later studies: of ^{256}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}Fm Levels

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

Cross Reference (XREF) Flags

- A ^{256}Es β^- decay (25.4 min)
- B ^{256}Es β^- decay (7.6 h)
- C ^{256}Md ε decay (77.7 min)

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

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Adopted Levels, Gammas (continued)

^{256}Fm Levels (continued)

E(level)†	Jπ	$T_{1/2}$	XREF	Comments
				branching ratios of deexciting gammas, 1989Ha10 suggested $J^\pi=3^+$ which is consistent with absence of γ to the 0^+ g.s.
1123.0& *5*	(6^-)		B	
1150.3?@	(8^+)		B	
1150.4a *4*	(4^+)		B	
1213.5?& *11*	(7^-)		B	
1251.6b *4*	(5^+)		B	Jπ: γ transitions to (3^+) and (4^+) states of K=2 band, but no γ to 2^+ bandhead imply J^π of 5^+ for the 1251.6 level.
1326.17 *18*	(1^+)		C	Proposed configuration=ν7/2[613]⊗ν9/2[615] (2000Ah02).
1328.3?b *4*	(6^+)		B	Jπ: from probable (E1) character of the 96.8γ from (7^-) isomeric state.
1360.4 *3*	(2^+)		C	Proposed configuration=ν7/2[613]⊗ν9/2[615] (2000Ah02).
1374.19 *18*	(1^-)		C	Proposed configuration=π7/2[633]⊗π7/2[514] (2000Ah02).
1405.27 *21*	(2^-)		C	Proposed configuration=π7/2[633]⊗π7/2[514] (2000Ah02).
1425.1 *3*	(7^-)	70 ns *5*	B	%IT=100 $T_{1/2}$: from 1989Ha10 by $(\beta)(231\gamma)$(t) data. The observed β-delayed fission activities were consistent with this half-life. The partial half-life for fission was deduced by 1989Ha10 as 0.8 ms *+88−7* from the β-delayed-fission probability of 2×10^{-5} (measured number of delayed fissions/total number of β^- decays of 7.6-h ^{256}Es; two fission events were observed.). Jπ: γ transitions to 8^+ and (5^-) states, relative photon intensities of deexciting γ rays, and nonobservation of transitions to 5^+, 4^+ states suggest $J^\pi=(7^-)$. 1989Ha10 pointed out that this level could be analogous to the 7^-,two-quasiparticle state predicted for ^{254}Fm by 1964So02: $K^\pi=7^-$, π7/2[633]⊗π7/2[514].
1559.8 *4*	$(7^+,8^+)$		B	Jπ: log *ft* for the β branch from 7.6-h ^{256}Es indicates an allowed transition, if completion of the decay scheme would not decrease β intensity considerably. If J^π(7.6-h ^{256}Es parent)=8^+, then π(1560 level)=+. From γ transition to the (7^-) state, $J^\pi=7^+$ or 8^+ may be deduced. Because of the assumptions made, however, these suggested spins should be considered as very tentative.

† From least-squares fit to Eγ values.
‡ Strong evidence for the presence of rotational band based on g.s.
# Band(A): $K^\pi=0^+$ band.
@ Band(B): $K^\pi=(2^+)$ γ-vibrational band.
& Band(C): $K^\pi=(2^-)$ octupole-vibrational band.
a Band(D): $K^\pi=(3^+)$ band.
b Band(E): $K^\pi=(5^+)$ band.

γ(^{256}Fm)

E_i(level)	J_i^π	E_γ†	I_γ†	E_f	J_f^π	Mult.	α#	$I_{(\gamma+ce)}$
48.12	2^+	(48.3‡ *3*)		0.0	0^+	[E2]	832	100
159.60	4^+	111.6 *2*	100	48.12	2^+	[E2]	15.96	
332.2	6^+	172.6 *2*	100	159.60	4^+	[E2]	2.40	
563.3	8^+	231.1 *2*	100	332.2	6^+	[E2]	0.772	
682.21	(2^+)	634.1a *2*	94a *10*	48.12	2^+			
		682.2 *2*	100	0.0	0^+			
725.43	(3^+)	565.9 *3*	23 *4*	159.60	4^+			
		677.4 *2*	100 *8*	48.12	2^+			
783.20	(4^+)	450.8 *15*	13	332.2	6^+			

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Adopted Levels, Gammas (continued)

γ(^{256}Fm) (continued)

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

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Adopted Levels, Gammas (continued)

$\gamma(^{256}Fm)$ (continued)

E_i(level)	J_i^π	E_γ †	I_γ †	E_f	J_f^π	Mult.	α #
1425.1	(7$^-$)	861.8 *2*	100	563.3	8$^+$		
		1092.9 *2*	47	332.2	6$^+$		
1559.8	(7$^+$,8$^+$)	134.7 *2*	100	1425.1	(7$^-$)	[E1]	0.0735

† From 7.6-h ^{256}Es β^- decay or ^{256}Md ε decay, when independent levels are populated in each. For 682 and 725 levels, populated in both the decays, unweighted averages are taken.
‡ Transition has not been observed; its energy is from level scheme.
# Theoretical values from BrIcc code (2008Ki07) using "Frozen orbital" approximation.
@ Multiply placed.
& Multiply placed with undivided intensity.
a Multiply placed with intensity suitably divided.
b Placement of transition in the level scheme is uncertain.

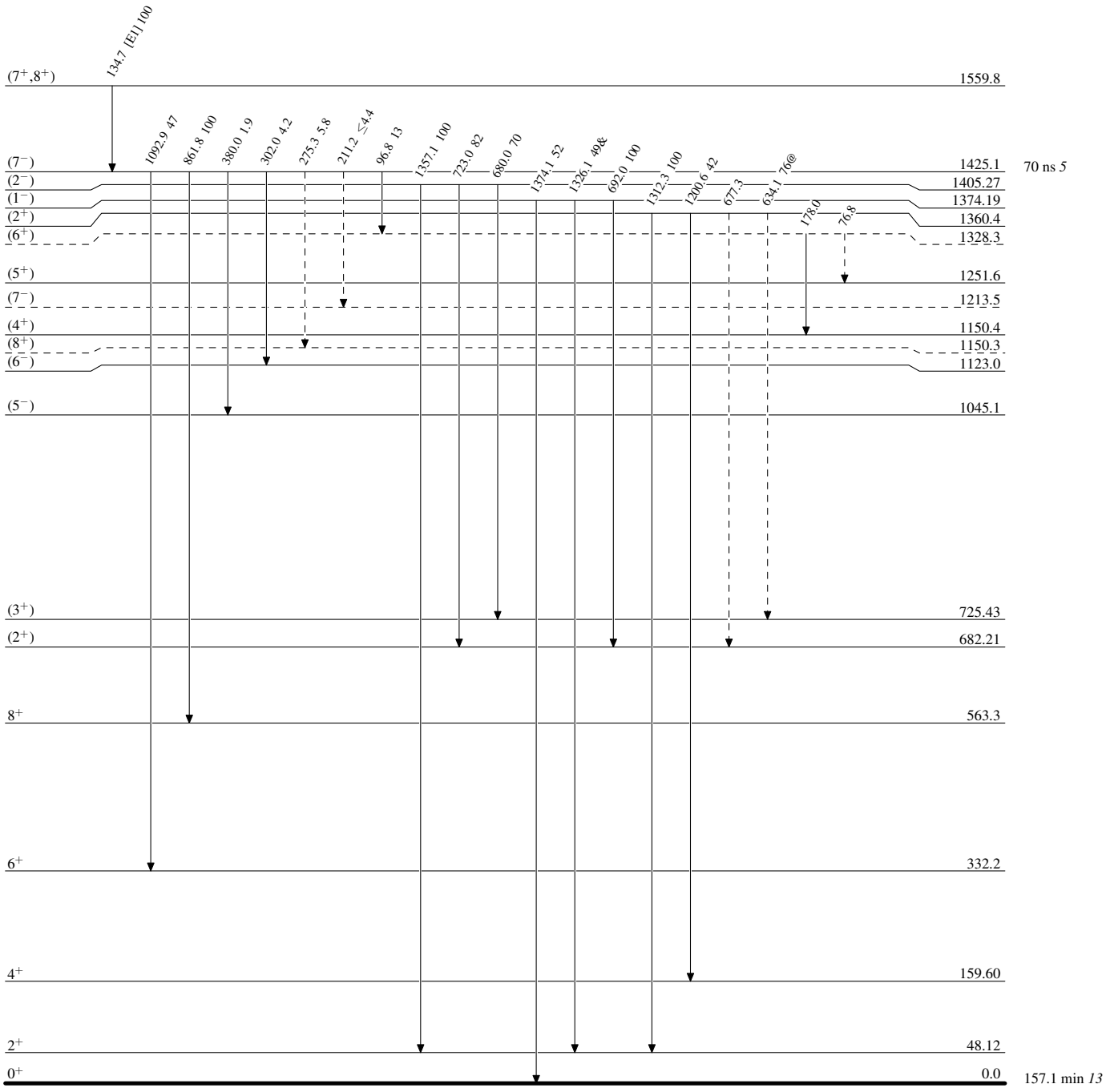
Adopted Levels, Gammas

Level Scheme

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

Legend

- - - - - - ► γ Decay (Uncertain)



$^{256}_{100}Fm_{156}$

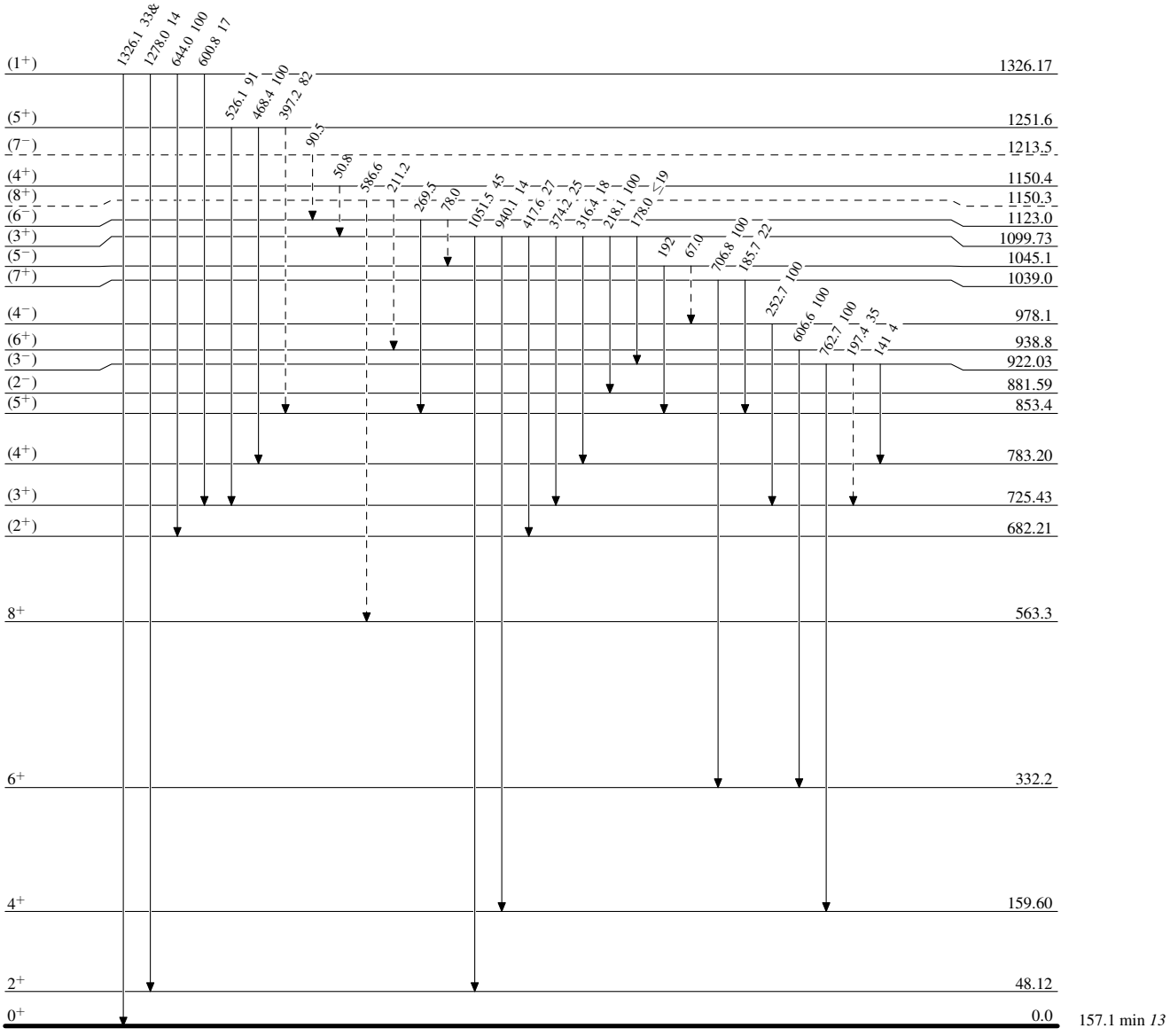
Adopted Levels, Gammas

Level Scheme (continued)

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

Legend

- - - - - - ► γ Decay (Uncertain)



$^{256}_{100}Fm_{156}$

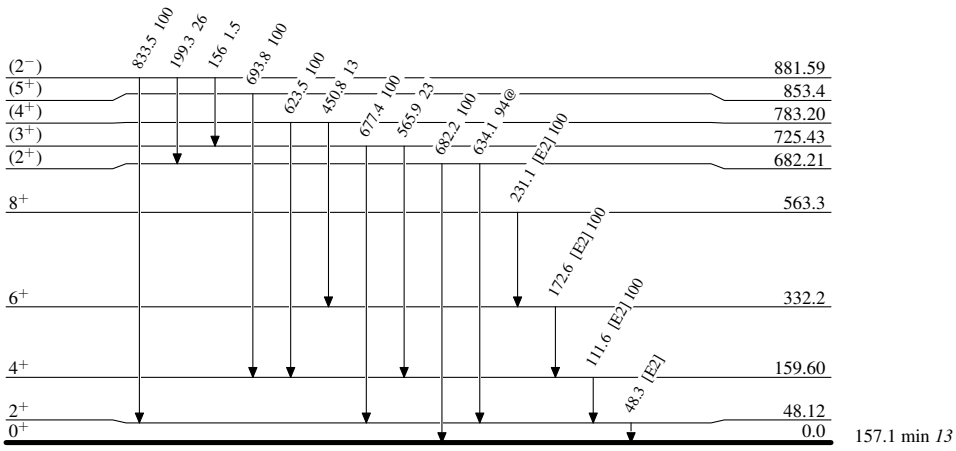
Adopted Levels, Gammas

Level Scheme (continued)

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

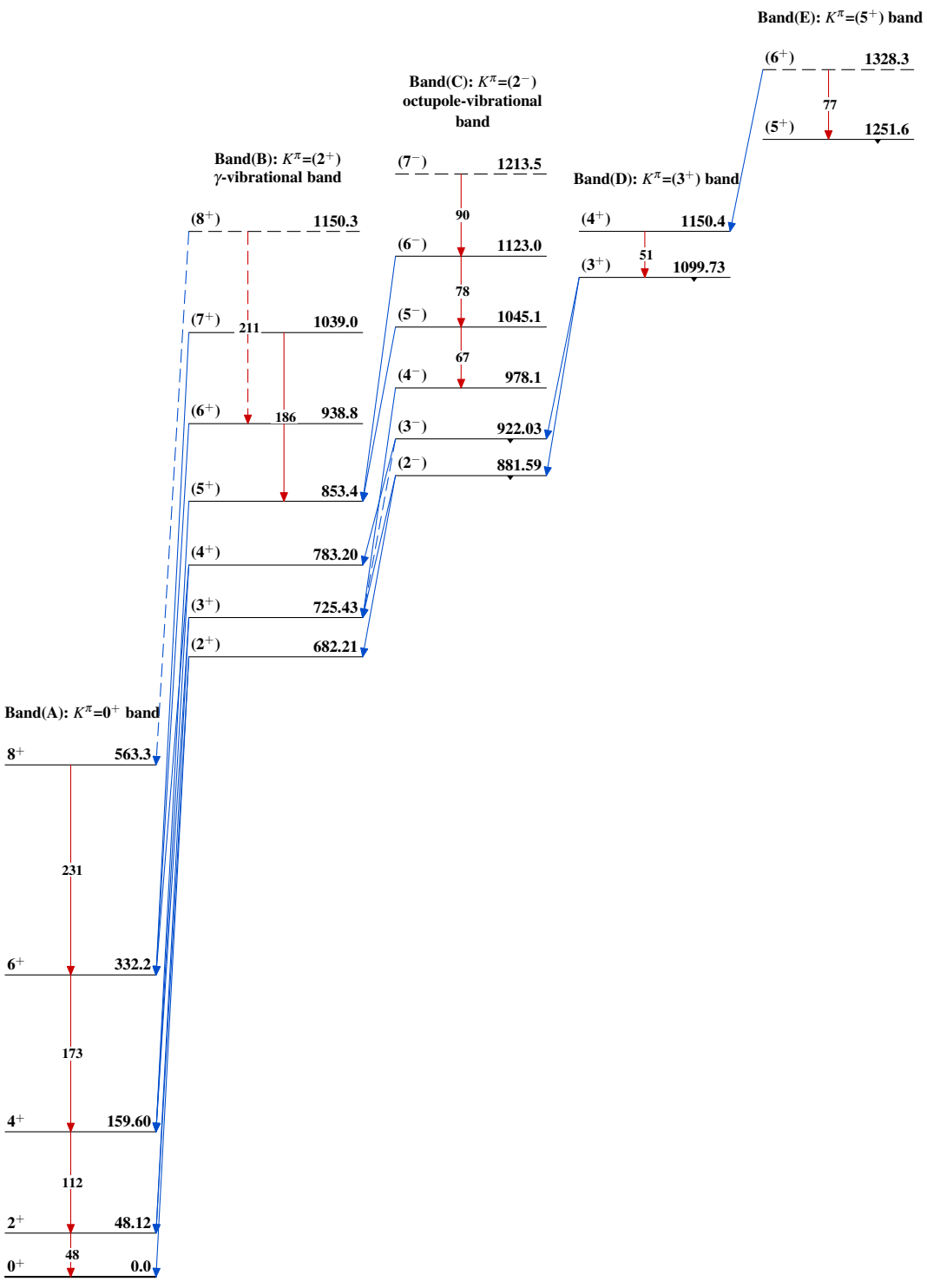
Legend

- - - - - - ► γ Decay (Uncertain)



$^{256}_{100}Fm_{156}$

Adopted Levels, Gammas



$^{256}_{100}Fm_{156}$