^{159}Pm IT decay (4.97 μs) 2021Yo08

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh	ENSDF	07-June-2023

Parent: ^{159}Pm: E=1495.0 *3*; J^{π}=(17/2$^+$); $T_{1/2}$=4.97 μs *12*; %IT decay=100

Adapted from a dataset in the XUNDL database compiled by E.A. McCutchan (NNDC,BNL), September 01, 2021.

2021Yo08: ^{159}Pm isomer produced in in-flight fission of ^{238}U in ^{9}Be(^{238}U,F),E=345 MeV/nucleon reaction, followed by separation of fission fragments using the BigRIPS separator at RIBF-RIKEN facility. Measured delayed γ rays, Eγ, Iγ, γγ-coin, isomer half-life by γ(t), (recoils)γ-coin using the EURICA array of 12 Euroball cluster HPGe detectors. Projected shell model calculation for 3-qp states.

Additional information 1.

^{159}Pm Levels

E(level)†	J^{π}‡	$T_{1/2}$	Comments
0.0#	(5/2$^-$)		
62.9# *2*	(7/2$^-$)		Transition intensity balance=−30 *70* (evaluator).
144.4# *2*	(9/2$^-$)		Transition intensity balance=+20 *40* (evaluator).
243.7# *3*	(11/2$^-$)		Transition intensity balance=19 *22* (evaluator).
313.5@ *3*	(5/2$^+$)		Transition intensity balance=9.4 *13* (evaluator).
363.0# *3*	(13/2$^-$)		Transition intensity balance=13 *10* (evaluator).
383.1@ *2*	(7/2$^+$)		Transition intensity balance=−6 *3* (evaluator).
473.6@ *6*	(9/2$^+$)		Transition intensity balance: data not available.
495.4# *3*	(15/2$^-$)		Transition intensity balance=−2 *5* (evaluator).
580.0@ *3*	(11/2$^+$)		Transition intensity balance=−6 *3* (evaluator).
654.1# *4*	(17/2$^-$)		Transition intensity balance=5.6 *23*; probably other transition(s) feed this level (evaluator).
706.6@ *8*	(13/2$^+$)		Transition intensity balance: data not available.
850.6@ *4*	(15/2$^+$)		Transition intensity balance=−0.2 *23* (evaluator).
933.2 *3*	(11/2,9/2)		Transition intensity balance=−1.6 *20* (evaluator).
1164.8 *3*	(15/2,13/2)		Transition intensity balance=−8 *5* (evaluator).
1495.0 *3*	(17/2$^+$)	4.97 μs *12*	%IT=100 $T_{1/2}$: from (270.6γ+330.3γ+644.4+801.7γ+921.2γ)(t) (2021Yo08) Authors also deduced $T_{1/2}$ values for each γ(t): 2.7 μs *14* for 81.2γ, 4.5 μs *23* for 99.0γ, 2.8 μs *12* for 119.2γ, 4 μs *4* for 164.7γ, 5 μs *4* for 180.9γ, 8.3 μs *12* for 197.2γ, 5.1 μs *25* for 218.2γ, 5.4 μs *23* for 231.8γ, 3.1 μs *4* for 251.7γ, 4.3 μs *9* for 270.6γ, 3.1 μs *4* for 313.4γ, 4.51 μs *16* for 330.3γ, 5.8 μs *5* for 644.4γ, 2.9 μs *9* for 669.4γ, 5.5 μs *7* for 788.8γ, 3.9 μs *9* for 801.7γ, and 5.8 μs *5* for 921.2γ, from which evaluator deduces a weighted averaged value of 4.40 μs *23*, but with reduced χ^2=3.6 as compared to critical χ^2=1.6; unweighted average is 4.51 μs *35*. Proposed configuration=π5/2[532]⊗ν7/2[633]⊗ν5/2[523] (2021Yo08).

† From least-squares fit to Eγ data.

‡ As assigned by 2021Yo08, based on shell-model calculations, and systematics of neighboring nuclei. The same assignments are given in the Adopted Levels.

Band(A): π5/2[532] band. Band assignment from 2021Yo08.

@ Band(B): π5/2[413] band. Band assignment from 2021Yo08.

^{159}Pm IT decay (4.97 μs) 2021Yo08 (continued)

$\gamma(^{159}Pm)$

Iγ normalization: Summed I(γ+ce)=100 for 330.2γ, 644.4γ, 841.0γ and 999.6γ from the 1495, (17/2$^+$) isomer. Evaluator has assumed that no other transition deexcites the isomer, in addition to assumption of dipole or E2 multipolarity for the 330.3-keV transition for the purpose of conversion coefficients. Other γ-normalization factor=0.58 *10* from I(γ+ce)=100 for transitions feeding the g.s. and the 62.8−keV level, omitting the 62.8−keV transition whose intensity is poorly known. Note that four γ rays, with a total I(γ+ce of 26.5 *32*, remain unplaced in the decay scheme.

If the decay scheme were well established, transition intensity balance at each of the intermediate level should be near zero. Lack of experimental information about δ(E2/M1) values for low-energy transitions, with expected large conversion coefficients, prevents better analysis of transition intensity balances in the decay scheme. Evaluator has listed apparent transition intensity balances in comments for levels, deduced from the present decay scheme.

E$_\gamma$[‡]	I$_\gamma$[‡&]	E$_i$(level)	J$_i^\pi$	E$_f$	J$_f^\pi$	Mult.[†]	α[a]	Comments
62.8 *3*	13 *6*	62.9	(7/2$^-$)	0.0	(5/2$^-$)	[M1+E2]	9 *4*	
(69.6)		383.1	(7/2$^+$)	313.5	(5/2$^+$)	[M1+E2]	6.5 *22*	E$_\gamma$: transition proposed from 313γ in coin with 197γ (2021Yo08). This transition was not observed due to self absorption and large internal conversion. I(γ+ce)=9 *4* from transition intensity balance.
81.2 *3*	32 *8*	144.4	(9/2$^-$)	62.9	(7/2$^-$)	[M1+E2]	3.8 *11*	
99.0 *3*	42 *8*	243.7	(11/2$^-$)	144.4	(9/2$^-$)	[M1]	2.0 *4*	
106.4[#]		580.0	(11/2$^+$)	473.6	(9/2$^+$)	[M1+E2]	1.6 *3*	I(γ+ce)=9 *4* from transition intensity balance.
119.2 *3*	33 *6*	363.0	(13/2$^-$)	243.7	(11/2$^-$)	[M1+E2]	1.07 *14*	
132.5 *3*	13 *3*	495.4	(15/2$^-$)	363.0	(13/2$^-$)	[M1+E2]	0.76 *7*	
144.0[#@]		850.6	(15/2$^+$)	706.6	(13/2$^+$)			I(γ+ce)≈0.4 from transition intensity balance.
144.3 *3*	7 *2*	144.4	(9/2$^-$)	0.0	(5/2$^-$)	[E2]	0.617 *10*	
158.7 *3*	11.5 *21*	654.1	(17/2$^-$)	495.4	(15/2$^-$)	[M1+E2]	0.432 *14*	
159[#@]		473.6	(9/2$^+$)	313.5	(5/2$^+$)			
[x]164.7 *3*	6.2 *22*					[D,E2]	0.23 *16*	
180.9 *3*	9.5 *19*	243.7	(11/2$^-$)	62.9	(7/2$^-$)	[E2]	0.284 *4*	
197.2 *3*	14.3 *23*	580.0	(11/2$^+$)	383.1	(7/2$^+$)	[E2]	0.2120 *32*	
218.2	9.3 *17*	363.0	(13/2$^-$)	144.4	(9/2$^-$)	[E2]	0.1513 *21*	
231.8 *3*	8.2 *24*	1164.8	(15/2,13/2)	933.2	(11/2,9/2)	[D,E2]	0.09 *6*	
233.0		706.6	(13/2$^+$)	473.6	(9/2$^+$)			I(γ+ce)≈0.4 from transition intensity balance.
251.7 *3*	8.8 *20*	495.4	(15/2$^-$)	243.7	(11/2$^-$)	[E2]	0.0948 *14*	
270.6 *3*	27.9 *26*	850.6	(15/2$^+$)	580.0	(11/2$^+$)	[E2]	0.0751 *11*	
291.1[#]		654.1	(17/2$^-$)	363.0	(13/2$^-$)			
313.4 *3*	13.8 *17*	313.5	(5/2$^+$)	0.0	(5/2$^-$)	[E1]	0.01265 *18*	
320.2 *3*	4.2 *22*	383.1	(7/2$^+$)	62.9	(7/2$^-$)	[E1]	0.01199 *17*	
330[#@]		473.6	(9/2$^+$)	144.4	(9/2$^-$)			
330.2 *3*	100 *5*	1495.0	(17/2$^+$)	1164.8	(15/2,13/2)	[D,E2]	0.035 *23*	
383.4 *3*	4.5 *14*	383.1	(7/2$^+$)	0.0	(5/2$^-$)	[E1]	0.00769 *11*	

$^{159}_{61}Pm_{98}$-2

^{159}Pm IT decay (4.97 μs) 2021Yo08 (continued)

$\gamma(^{159}Pm)$ (continued)

E_γ[‡]	I_γ[‡&]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[†]	α[a]	Comments
435.2 *3*	4.0 *10*	580.0	(11/2$^+$)	144.4	(9/2$^-$)	[E1]	0.00568 *8*	
[x]482.7 *3*	6.4 *12*					[D,E2]	0.013 *9*	
644.4 *3*	30.1 *19*	1495.0	(17/2$^+$)	850.6	(15/2$^+$)	[M1+E2]	0.0085 *21*	If E2, reduced hindrance factor (f_ν)=22 *2* (2021Yo08).
669.4 *3*	13.3 *15*	1164.8	(15/2,13/2)	495.4	(15/2$^-$)	[D,E2]	0.006 *4*	
[x]774.7 *3*	5.4 *15*							
788.8 *3*		933.2	(11/2,9/2)	144.4	(9/2$^-$)			2021Yo08 mentioned that the 789-keV peak could contain the γ ray from the $LaBr_3$ detectors in the experimental setup but concluded that it was mainly from the decay of the isomer.
801.7 *3*	36.2 *24*	1164.8	(15/2,13/2)	363.0	(13/2$^-$)	[D,E2]	0.0038 *24*	
841.0 *3*	8.2 *14*	1495.0	(17/2$^+$)	654.1	(17/2$^-$)	[E1]	1.37×10^{-3} *2*	
870.5 *3*	6.5 *12*	933.2	(11/2,9/2)	62.9	(7/2$^-$)	[D,E2]	0.0027 *14*	
[x]895.8 *3*	7.0 *13*							
921.2 *3*	32.6 *24*	1164.8	(15/2,13/2)	243.7	(11/2$^-$)	[D,E2]	0.0028 *16*	
999.6 *3*	5.9 *12*	1495.0	(17/2$^+$)	495.4	(15/2$^-$)	[E1]	9.83×10^{-4} *14*	

[†] Assumed based on J^π assignments in 2021Yo08.
[‡] From 2021Yo08. Uncertainty of 0.3 keV is assigned for Each Eγ value, based on a statement in 2021Yo08 that systematic uncertainties in Eγ values are 0.32 keV, being the main source of uncertainties. Values listed to nearest keV are from level-scheme Fig. 3 in 2021Yo08.
[#] This γ observed only in $\gamma\gamma$-coin mode, Eγ from level-energy difference.
[@] This γ hidden by a larger peak at close energy, Eγ from level-energy difference.
[&] For absolute intensity per 100 decays, multiply by 0.676 *32*.
[a] Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.
[x] γ ray not placed in level scheme.

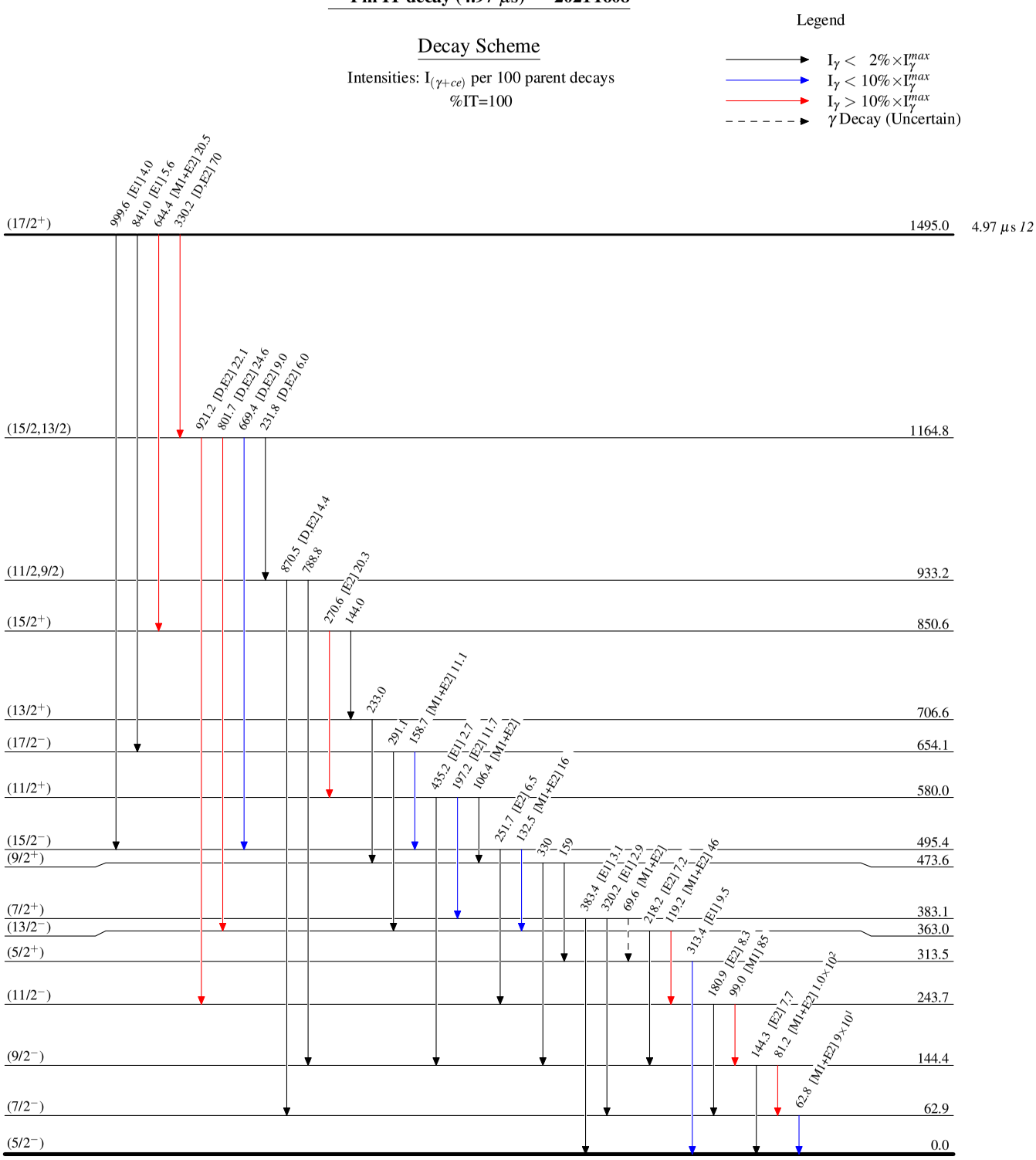
$^{159}_{61}Pm_{98}$-3

^{159}Pm IT decay (4.97 μs) 2021Yo08

Decay Scheme

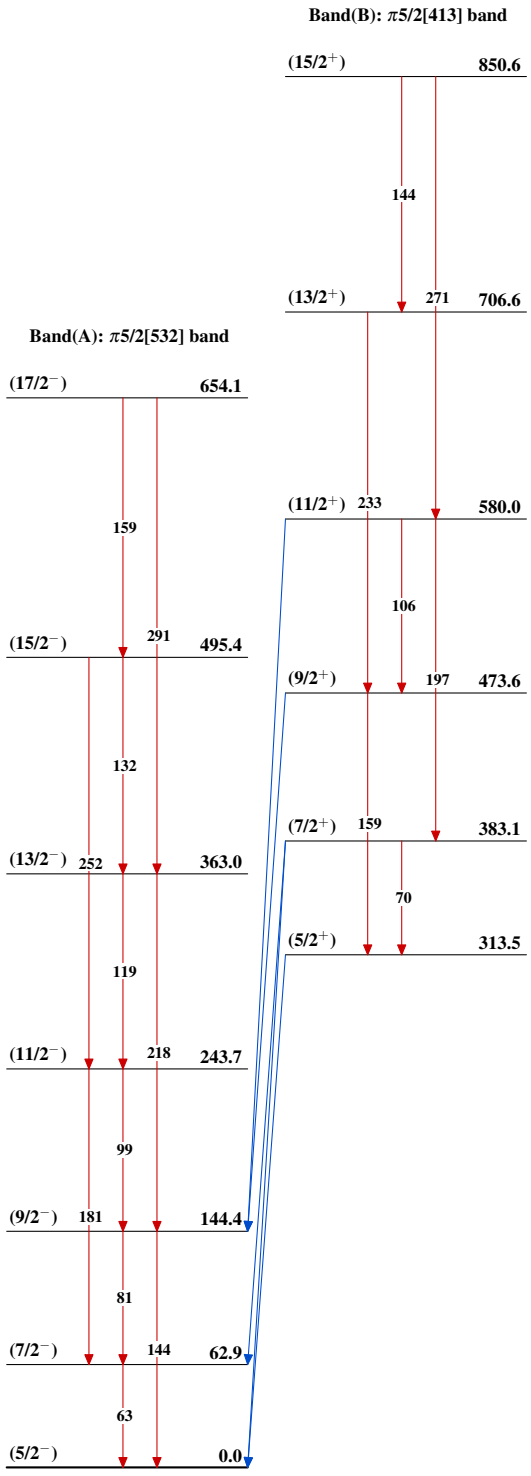
Intensities: $I_{(\gamma+ce)}$ per 100 parent decays

%IT=100



$^{159}_{61}Pm_{98}$

^{159}Pm IT decay (4.97 μs) 2021Yo08



$^{159}_{61}Pm_{98}$