^{140}Pm ε decay (5.95 min) 1975Ke09,2009Wi18

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	N. Nica	NDS 154, 1 (2018)	20-Nov-2018

Parent: ^{140}Pm: E=0.0+x *28*; J$^{\pi}$=8^{-}; T$_{1/2}$=5.95 min *5*; Q(ε)=6045 *24*; %ε+%β^{+} decay=100.0
^{140}Pm-E: x=431 *28* (difference of Q values for ε decay of 9.2 s and 5.95 min of ^{140}Pm, 2017Au03).
^{140}Pm-J$^{\pi}$,T$_{1/2}$: from ^{140}Pm Adopted Levels.
^{140}Pm-Q(ε): from 2017Wa10.
1975Ke09: measured γ, $\gamma\gamma$, β^{+} at Foster Radiation Laboratory at McGill University.
2009Wi18 (and 2009WiZV): measured Eγ, Iγ, $\gamma\gamma$, $\gamma\gamma(\theta)$, mixing ratios using eight Compton-suppressed high-purity Ge clover detectors at the Wright Nuclear Structure Laboratory (WNSL) at Yale University.
Others: 1966At04, 1967Bl27, 1973VaYZ, 1973HaWA, 1974FiZF, 1975Za10.
Measured: γ, ce (semi), $\gamma\gamma$ (semi-semi), β^{+} (scin).
Of the two main references presented above 1975Ke09 give separate level schemes for each of the 9.2 s, 1^{+} g.s. and for the 5.95 min, 8^{-} isomer ε+β^{+} decays, while 2009Wi18 give a single level scheme for both decays. The evaluator attempted a separation of the 2009Wi18 data into two separate level schemes based on the fact the only common element of the two level schemes is the 773γ from the first 2^{+} state to g.s. in ^{140}Nd (and all spins in 2009Wi18 data seem to cluster either around 1^{+} or around 8^{-}). However when checking the intensity balances some anomalous situations were found. For example the levels 2276, 5^{-} and 2366, 6^{+} whose J^{π} values were established independently of the ε+β^{+} decay, have their beta feeding in accordance with these J^{π} values in the level scheme of 1975Ke09; however with the data from 2009Wi18 the feeding of the 2276 level is about 10 times bigger which would be compatible with a spin value closer to 8, while the feeding of the 2366 level is negative indicating a very forbidden beta branch, so a much smaller spin value than 6. As these assignments are incompatible with the independently established J^{π} values, and with the fact that the separation of the two level schemes could be much more properly done by the authors, the evaluator did not include in the present dataset the data from 2009Wi18 (except where mentioned below). The interested reader can see the xundl file available online (compiled after 2009Wi18 by B. Karamy and B. Singh (McMaster).

^{140}Nd Levels

E(level)†	J$^{\pi}$‡	T$_{1/2}$‡	Comments
0.0	0^{+}	3.37 d *2*	%ε=100 %ε: from Adopted Levels.
773.60 *10*	2^{+}	1.40 ps *11*	
1801.70 *10*	4^{+}		
2221.51 *10*	7^{-}	0.60 ms *5*	
2275.93 *13*	5^{-}		
2366.23 *13*	6^{+}		
2842.23 *13*	7$^{(-)}$		
2943.22 *13*	(6^{+},7^{-})		
3060.75 *14*	7^{-}		
3238.8 *5*	8^{-}		
3418.51 *15*	7,8,9$^{(-)}$		
3672.73 *15*	7$^{(-)}$		
4349.32 *25*	7,8,9		
4366.9 *8*	7,8,9$^{(-)}$		

† From least-squares fit to the Eγ's.
‡ Adopted values.

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ε,β^+ radiations

E(decay)	E(level)	Iβ^+ †	Iε†	Log *ft*	I(ε+β^+)†	Comments
(1678 *24*)	4366.9	0.051 *9*	0.70 *10*	6.15 *7*	0.75 *11*	av Eβ=493 *17*; εK=0.788 *7*; εL=0.1126 *10*; εM+=0.0322 *3*
(1696 *24*)	4349.32	0.011 *4*	0.14 *6*	6.86 *18*	0.15 *6*	av Eβ=501 *17*; εK=0.785 *7*; εL=0.1121 *10*; εM+=0.0321 *3*
(2372 *24*)	3672.73	0.13 *2*	0.35 *5*	6.70 *7*	0.48 *7*	av Eβ=802 *17*; εK=0.619 *11*; εL=0.0877 *16*; εM+=0.0251 *5*
(2626 *24*)	3418.51	1.3 *1*	2.4 *2*	5.95 *4*	3.7 *3*	av Eβ=917 *17*; εK=0.543 *11*; εL=0.0768 *16*; εM+=0.0219 *5*
(2806 *24*)	3238.8	0.26 *5*	0.35 *6*	6.83 *8*	0.61 *11*	av Eβ=999 *17*; εK=0.490 *11*; εL=0.0692 *16*; εM+=0.0198 *5*
(2984 *24*)	3060.75	0.26 *6*	0.29 *6*	6.97 *10*	0.55 *12*	av Eβ=1080 *17*; εK=0.441 *10*; εL=0.0621 *15*; εM+=0.0177 *4*
(3102 *24*)	2943.22	0.21 *8*	0.19 *7*	7.17 *17*	0.40 *15*	av Eβ=1134 *17*; εK=0.410 *10*; εL=0.0577 *14*; εM+=0.0165 *4*
(3203 *24*)	2842.23	0.16 *8*	0.13 *7*	7.36 *23*	0.29 *15*	av Eβ=1180 *17*; εK=0.384 *9*; εL=0.0542 *13*; εM+=0.0155 *4*
(3679 *24*)	2366.23	0.35 *9*	0.18 *4*	7.34 *11*	0.53 *13*	av Eβ=1400 *17*; εK=0.283 *7*; εL=0.0398 *10*; εM+=0.0114 *3*
(3769 *24*)	2275.93	<0.3	<0.1	>7.5	<0.4	av Eβ=1442 *18*; εK=0.267 *7*; εL=0.0375 *9*; εM+=0.0107 *3*
4249 *28*	2221.51	63.4 *17*	27.8 *10*	5.173 *21*	91.2 *22*	av Eβ=1467 *18*; εK=0.258 *7*; εL=0.0362 *9*; εM+=0.01034 *25* E(decay): from Q(ε)=6484 *70* measured by 1975Ke09 and adjusted by 2012AU05 to 6471 *28*.

† Absolute intensity per 100 decays.

γ(^{140}Nd)

Iγ normalization: ΣIγ(g.s.)=100%.

E_γ	I_γ ‡b	E_i(level)	J^π_i	E_f	J^π_f	Mult.#@	α†	Comments
90.1 *2*	0.19 *3*	2366.23	6^+	2275.93	5^-	E1	0.345 *6*	α(K)=0.291 *5*; α(L)=0.0422 *7*; α(M)=0.00891 *14* α(N)=0.00196 *3*; α(O)=0.000281 *5*; α(P)=1.430×10^{-5} *22* Mult.: from α(K)exp=0.26 *20*.
144.9 *1*	0.35 *4*	2366.23	6^+	2221.51	7^-	E1	0.0940	α(K)=0.0800 *12*; α(L)=0.01107 *16*; α(M)=0.00233 *4* α(N)=0.000516 *8*; α(O)=7.56×10^{-5} *11*; α(P)=4.18×10^{-6} *6* Mult.: from α(K)exp=0.11 *7*.
177.8 *1*	0.12 *2*	3238.8	8^-	3060.75	7^-	M1(+E2)	0.286 *7*	α(K)=0.224 *15*; α(L)=0.049 *16*; α(M)=0.0107 *37* α(N)=0.00234 *78*; α(O)=3.29×10^{-4} *92*; α(P)=1.3×10^{-5} *3*
^{x}257.9& *4*	1.4 *8*							
419.81 *1*	92 *2*	2221.51	7^-	1801.70	4^+	E3	0.0598	α(K)=0.0437 *7*; α(L)=0.01256 *18*; α(M)=0.00282 *4* α(N)=0.000619 *9*; α(O)=8.54×10^{-5} *12*; α(P)=2.64×10^{-6} *4* E_γ: from 1974FiZF. Mult.: from α(K)exp=4.7×10^{-2} *4* (1975Ke09), K/L=3.9 *6* (1973VaYZ).

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^{140}Pm ε decay (5.95 min) 1975Ke09,2009Wi18 (continued)

γ(^{140}Nd) (continued)

Eγ	Iγ[‡b]	Ei(level)	$J^π_i$	Ef	$J^π_f$	Mult.[#@]	α[†]	Comments
474.2 *1*	1.0 *2*	2275.93	5⁻	1801.70	4⁺	E1	0.00445	α(K)=0.00382 *6*; α(L)=0.000498 *7*; α(M)=0.0001048 *15* α(N)=2.34×10⁻⁵ *4*; α(O)=3.52×10⁻⁶ *5*; α(P)=2.21×10⁻⁷ *3* Mult.: from α(K)exp=0.005 *6*.
564.5 *2*	0.20 *10*	2366.23	6⁺	1801.70	4⁺	E2	0.00855	α(K)=0.00713 *10*; α(L)=0.001119 *16*; α(M)=0.000240 *4* α(N)=5.33×10⁻⁵ *8*; α(O)=7.83×10⁻⁶ *11*; α(P)=4.22×10⁻⁷ *6*
566.30 *3*	0.29 *15*	2842.23	7⁽⁻⁾	2275.93	5⁻			
ˣ635.1[&] *4*	0.4							
ˣ651.8[&] *4*	0.5 *3*							
667.3 *1*	0.20 *10*	2943.22	(6⁺,7⁻)	2275.93	5⁻			
695.1 *2*	0.20 *4*	3060.75	7⁻	2366.23	6⁺	(E1)	0.00192	α(K)=0.001652 *24*; α(L)=0.000212 *3*; α(M)=4.46×10⁻⁵ *7* α(N)=9.95×10⁻⁶ *14*; α(O)=1.506×10⁻⁶ *22*; α(P)=9.70×10⁻⁸ *14*
721.7 *1*	0.20 *10*	2943.22	(6⁺,7⁻)	2221.51	7⁻			
773.74 *6*	100 *5*	773.60	2⁺	0.0	0⁺	E2	0.00396	α(K)=0.00334 *5*; α(L)=0.000483 *7*; α(M)=0.0001028 *15* α(N)=2.29×10⁻⁵ *4*; α(O)=3.42×10⁻⁶ *5*; α(P)=2.01×10⁻⁷ *3* Eγ: from 1974FiZF. Mult.: from K/L=6.3 *10* (1973VaYZ), syst.
839.1 *1*	0.50 *10*	3060.75	7⁻	2221.51	7⁻	M1(+E2)	0.0042 *10*	α(K)=0.0036 *8*; α(L)=0.00049 *10*; α(M)=0.000103 *19* α(N)=2.3×10⁻⁵ *5*; α(O)=3.5×10⁻⁶ *7*; α(P)=2.2×10⁻⁷ *6*
ˣ880.4[&] *4*	0.5 *4*							
930.8 *2*	0.15 *6*	4349.32	7,8,9	3418.51	7,8,9⁽⁻⁾			
1017.3 *4*	0.45 *10*	3238.8	8⁻	2221.51	7⁻	M1+E2	0.0027 *6*	α(K)=0.0023 *5*; α(L)=0.00031 *6*; α(M)=6.5×10⁻⁵ *12* α(N)=1.5×10⁻⁵ *3*; α(O)=2.2×10⁻⁶ *5*; α(P)=1.4×10⁻⁷ *4*
1028.19 *7*	100 *2*	1801.70	4⁺	773.60	2⁺	E2	0.00211	A₂=+0.09 *1*; A₄=+0.04 *1* α(K)=0.00180 *3*; α(L)=0.000247 *4*; α(M)=5.22×10⁻⁵ *8* α(N)=1.165×10⁻⁵ *17*; α(O)=1.755×10⁻⁶ *25*; α(P)=1.091×10⁻⁷ *16* Eγ: from 1974FiZF. Mult.: from α(K)exp=1.7×10⁻³ *2*. γγ(θ) for 1028-774 cascade.
ˣ1110.3[a] *5*	0.20 *4*							
1197.0 *1*	3.8 *2*	3418.51	7,8,9⁽⁻⁾	2221.51	7⁻			
ˣ1261.9[&] *4*	1.0 *3*							
1306.4 *2*	0.11 *3*	3672.73	7⁽⁻⁾	2366.23	6⁺			
1396.8 *1*	0.13 *3*	3672.73	7⁽⁻⁾	2275.93	5⁻			

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^{140}Pm ε decay (5.95 min) 1975Ke09,2009Wi18 (continued)

γ(^{140}Nd) (continued)

E_γ	I_γ[‡b]	E_i(level)	J^π_i	E_f	J^π_f
1451.6 5	0.24 5	3672.73	$7^{(-)}$	2221.51	7^-
[x]1486.4[a] 5	0.12 3				
[x]1733.8[&] 4	0.3 1				
[x]1837.8[&] 4	0.2 1				
[x]1907.1[a] 5	0.40 5				
[x]1957.4[a] 5	0.22 4				
2145.4 8	0.75 10	4366.9	$7,8,9^{(-)}$	2221.51	7^-
[x]2240.3[a] 5	0.20 4				
[x]2247.6[a] 5	0.14 3				
[x]2407.7 10	0.02 1				

† Additional information 1.
‡ Relative intensities from 1975Ke09.
# From α(K)exp (1973VaYZ, normalized to α(K)(773γ)=3.3×10^{-3} (E2), Iγ from 1975Ke09) and $\gamma\gamma(\theta)$ (2009Wi18).
@ A_2 and A_4 coefficients are from email reply from E. Williams, (2009Wi18) to XUNDL compiler November 25, 2009.
& Weak γ observed only by 1975Za10.
a Weak γ observed by 1975Ke09.
b Absolute intensity per 100 decays.
x γ ray not placed in level scheme.

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Decay Scheme

Intensities: Relative I_γ