^{138}Pm ε decay (3.24 min) 1981De38

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Jun Chen	NDS 146, 1 (2017)	30-Sep-2017

Parent: ^{138}Pm: E=x; J$^{\pi}$=(5$^-$); $T_{1/2}$=3.24 min *5*; Q(ε)=7078 *29*; %ε+%β^+ decay=100.0

^{138}Pm-E: 20 *100* from observed β decay energy difference, between Q(ε)(2000Be42)=7105 *19* and Q(ε)(1983Al06)=7090 *100*. Note that 2000Be42 did not observe the g.s. level with $T_{1/2}$=10 s in 1983Al06 and thus this 3.24 min level observed in 2000Be42 could also be the g.s. of ^{138}Pm.

^{138}Pm-J$^{\pi}$,$T_{1/2}$: From Adopted Levels of ^{138}Pm.

^{138}Pm-Q(ε): From 2017Wa10.

1981De38: Measured: ^{138}Pm ions were produced via ^{142}Nd(d,5n) with 98% enriched Nd_2O_3 targets bombarded with proton beams and also via ^{144}Sm(p,α3n). γ rays were detected with two Ge(Li) detectors (FWHM=1.9 and 2.3 keV at 1.33 MeV) and low-energy γ rays and X rays were detected with an hyperpure Ge X-ray spectrometer (FWHM=490 eV at 122 keV); conversion electrons were detected with a “mini-orange” electron spectrometer consisting of a Si(Li) detector and a magnetic filter. Measured Eγ, Iγ, $\gamma\gamma$-coin, E(X-ray)γ, E(ce), $\beta\gamma$-coin. decay-time distribution. Deduced levels, J, π, parent $T_{1/2}$, conversion coefficients, γ-ray multipolarities, decay branching ratios, log *ft*. Systematics of N=77 isotones.

Others: 1995Ve08 and 1983Al06 (end-point energy); 1992Si22 (magnetic moment); 1983GaZT, 1973VaYZ, 1973WeZK (half-life).

The experimental work of 1981De38 presents 2 problems: a) Levels with J^{π}=2$^+$ to 6$^+$ are populated with log *ft*=5.8-6.5, b) the measured Q(ε)=5.4 MeV *2* is about 1.5 MeV lower than more recent measurements. The first problem may be explained by either, a combined decay of two ^{138}Pm isomers, or by an incomplete decay scheme, that is, the higher spin levels are not directly fed in the ε+β^+ decay, they are instead populated by unplaced γ rays. Due to these problems, the only information from this data that is adopted is the measured $T_{1/2}$ and γ multipolarities and no decay branching ratios and log *ft* values are given.

^{138}Nd Levels

E(level)†	J$^{\pi}$‡	E(level)†	J$^{\pi}$‡	E(level)†	E(level)†
0.0	0$^+$	1990.3 *3*	5$^-$	2484.8 *4*	2961.0 *3*
520.89 *17*	2$^+$	2134.3 *5*	6$^+$	2623.2 *5*	3256.0 *11*
1014.00 *18*	2$^+$	2196.2 *4*		2625.7 *5*	3784.1 *4*
1249.93 *21*	4$^+$	2222.0 *4*	(5$^-$)	2710.3 *4*	3855.0 *4*
1451.50 *20*	(3)$^+$	2261.7 *3*	(2$^+$,3$^+$,4$^+$)	2758.7 *4*	3981.3 *4*
1799.92 *24*		2273.1 *4*	(1,2$^+$)	2934.6 *3*	4205.8 *6*
1843.01 *25*	(4$^+$)	2323.8 *4*		2940.8 *4*	4212.6 *5*

† From a least-squares fit to γ-ray energies.
‡ From Adopted Levels.

γ(^{138}Nd)

E_γ‡	I_γ‡	E_i(level)	J_i^π	E_f	J_f^π	Mult.#	α†	Comments
437.4 *2*	10.4 *6*	1451.50	(3)$^+$	1014.00	2$^+$	E2(+M1)	0.021 *5*	α(K)=0.018 *4*; α(L)=0.0027 *3*; α(M)=0.00057 *6* α(N)=0.000127 *13*; α(O)=1.89×10^{-5} *24*; α(P)=1.1×10^{-6} *3* Mult.: α(K)exp=0.0160 *15* (1981De38), α(K)exp=0.015 *3* (1973VaYZ).
493.1 *2*	21.6 *13*	1014.00	2$^+$	520.89	2$^+$	E2	0.01222	α(K)=0.01011 *15*; α(L)=0.001662 *24*; α(M)=0.000358 *5* α(N)=7.93×10^{-5} *12*; α(O)=1.156×10^{-5} *17*; α(P)=5.92×10^{-7} *9* Mult.: α(K)exp=0.0100 *10* (1981De38), α(K)exp=0.011 *3*, K/L=4.0 *15*(1973VaYZ).
520.9 *2*	100	520.89	2$^+$	0.0	0$^+$	E2	0.01055	α(K)=0.00876 *13*; α(L)=0.001412 *20*; α(M)=0.000304 *5* α(N)=6.73×10^{-5} *10*; α(O)=9.85×10^{-6} *14*; α(P)=5.15×10^{-7} *8* Mult.: α(K)exp=0.0093 *7* (1981De38), α(K)exp=0.009 *2* (1973VaYZ).
592.9 *3*	0.9 *1*	1843.01	(4$^+$)	1249.93	4$^+$			
699.0 *6*	0.5 *1*	2961.0		2261.7	(2$^+$,3$^+$,4$^+$)			
729.0 *2*	37.8 *23*	1249.93	4$^+$	520.89	2$^+$	E2	0.00455	α(K)=0.00384 *6*; α(L)=0.000561 *8*; α(M)=0.0001197 *17* α(N)=2.66×10^{-5} *4*; α(O)=3.96×10^{-6} *6*; α(P)=2.30×10^{-7} *4* Mult.: α(K)exp=0.0040 *4* (1981De38), α(K)exp=0.0040 *10*, K/L=5.5 *20* (1973VaYZ).
740.6 *3*	6.4 *5*	1990.3	5$^-$	1249.93	4$^+$	E1	1.68×10^{-3}	α(K)=0.001450 *21*; α(L)=0.000186 *3*; α(M)=3.90×10^{-5} *6* α(N)=8.71×10^{-6} *13*; α(O)=1.319×10^{-6} *19*; α(P)=8.53×10^{-8} *12* Mult.: α(K)exp<0.003 (1981De38).
786.0 *3*	0.9 *2*	1799.92		1014.00	2$^+$			
810.3 *3*	3.1 *3*	2261.7	(2$^+$,3$^+$,4$^+$)	1451.50	(3)$^+$	(M1)	0.00558	α(K)=0.00479 *7*; α(L)=0.000629 *9*; α(M)=0.0001327 *19* α(N)=2.97×10^{-5} *5*; α(O)=4.54×10^{-6} *7*; α(P)=3.02×10^{-7} *5* Mult.: α(K)exp=0.0055 *20* (1973VaYZ).
^{x}818.5 *4*	1.1 *3*							
829.0 *3*	7.1 *5*	1843.01	(4$^+$)	1014.00	2$^+$			Mult.: M1 from α(K)exp=0.0060 *10* (1981De38), α(K)exp=0.0041 *15* (1973VaYZ). This value is in conflict with the adopted J^π=(4$^+$).
884.4 *4*	0.8 *2*	2134.3	6$^+$	1249.93	4$^+$	E2	0.00293	α(K)=0.00248 *4*; α(L)=0.000349 *5*; α(M)=7.41×10^{-5} *11* α(N)=1.652×10^{-5} *24*; α(O)=2.48×10^{-6} *4*; α(P)=1.500×10^{-7} *21* Mult.: adopted value.
930.6 *2*	5.1 *3*	1451.50	(3)$^+$	520.89	2$^+$	M1(+E2)	0.0033 *7*	α(K)=0.0028 *7*; α(L)=0.00038 *7*; α(M)=8.0×10^{-5} *15* α(N)=1.8×10^{-5} *4*; α(O)=2.7×10^{-6} *6*; α(P)=1.8×10^{-7} *5* Mult.: α(K)exp=0.0031 *10* (1973VaYZ).
944.5 *3*	0.8 *2*	2934.6		1990.3	5$^-$			
970.7 *4*	0.8 *3*	2961.0		1990.3	5$^-$			
972.1 *3*	4.5 *3*	2222.0	(5$^-$)	1249.93	4$^+$	D		Mult.: α(K)exp=0.004 *2* (1981De38), α(K)exp=0.0018 *6* (1973VaYZ); α(K)exp is compatible with M1+E2 or E1+M2.

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γ(^{138}Nd) (continued)

E_γ ‡	I_γ ‡	E_i(level)	J^π_i	E_f	J^π_f	Mult.#	α†	Comments
1011.6 3	3.8 5	2261.7	(2^+,3^+,4^+)	1249.93	4^+			
1014.0 3	7.4 7	1014.00	2^+	0.0	0^+	E2	0.00218	α(K)=0.00185 3; α(L)=0.000254 4; α(M)=5.39×10^{-5} 8 α(N)=1.202×10^{-5} 17; α(O)=1.81×10^{-6} 3; α(P)=1.123×10^{-7} 16 Mult.: α(K)exp=0.0022 5 (1981De38), α(K)exp=0.0018 6 (1973VaYZ).
1033.2 4	0.3 1	2484.8		1451.50	$(3)^+$			
1091.9 6	0.8 4	2934.6		1843.01	(4^+)			
1097.5 6	1.2 4	2940.8		1843.01	(4^+)			
1117.8 4	0.7 2	2961.0		1843.01	(4^+)			
1134.6 3	2.5 3	2934.6		1799.92				
1140.9 3	0.8 2	2940.8		1799.92				
1161.4 4	0.7 2	2961.0		1799.92				
^{x}1214.5 4	0.5 1							
1258.8 5	0.3 1	2710.3		1451.50	$(3)^+$			
1259.2 5	0.5 2	2273.1	(1,2^+)	1014.00	2^+			
1279.1 3	11.0 8	1799.92		520.89	2^+			
^{x}1318.0 4	0.6 2							
^{x}1322.0 4	0.6 2							
^{x}1360.0 4	0.6 2							
1373.3 4	1.3 3	2623.2		1249.93	4^+			
1375.8 4	1.1 3	2625.7		1249.93	4^+			
1460.4 5	0.6 3	2710.3		1249.93	4^+			
1470.9 4	0.8 2	2484.8		1014.00	2^+			
1482.8 3	2.5 3	2934.6		1451.50	$(3)^+$			
1508.7 4	0.4 2	2758.7		1249.93	4^+			
1509.3 4	0.8 4	2961.0		1451.50	$(3)^+$			
^{x}1576.6 4	0.9 2							
1675.3 3	3.2 4	2196.2		520.89	2^+			
1711.1 4	1.5 3	2961.0		1249.93	4^+			
^{x}1736.5 4	0.7 2							
1744.8 4	1.1 2	2758.7		1014.00	2^+			
^{x}1789.8 5	0.6 2							
^{x}1800.5 5	0.3 1							
1802.9 3	1.7 3	2323.8		520.89	2^+			
^{x}1851.1 4	0.5 1							
^{x}1951.1 4	1.1 2							
1984.0 4	0.6 2	3784.1		1799.92				
^{x}2029.5 5	0.6 2							
^{x}2036.0 5	0.4 2							
2138.0 6	0.3 1	3981.3		1843.01	(4^+)			
2242.0 10	1.4 5	3256.0		1014.00	2^+			
2273.0 4	0.6 2	2273.1	(1,2^+)	0.0	0^+			
^{x}2303.0 5	0.8 3							
2332.8 6	0.3 1	3784.1		1451.50	$(3)^+$			
2369.3 6	0.7 3	4212.6		1843.01	(4^+)			

γ(^{138}Nd) (continued)

E_γ‡	I_γ‡	E_i(level)	J^π_i	E_f	J^π_f	E_γ‡	I_γ‡	E_i(level)	E_f	J^π_f	E_γ‡	I_γ‡	E_i(level)	E_f	J^π_f
2403.6 *6*	1.3 *4*	3855.0		1451.50	(3)$^+$	[x]2770.0 *10*	0.8 *4*				[x]3016.0 *10*	0.6 *2*			
2605.0 *4*	3.0 *5*	3855.0		1249.93	4$^+$	2841.0 *4*	0.5 *2*	3855.0	1014.00	2$^+$	[x]3139.0 *10*	0.4 *2*			
2731.3 *4*	1.1 *3*	3981.3		1249.93	4$^+$	2962.9 *6*	0.9 *3*	4212.6	1249.93	4$^+$	3460.5 *4*	2.9 *4*	3981.3	520.89	2$^+$
2754.3 *5*	0.2 *1*	4205.8		1451.50	(3)$^+$	[x]2966.0 *10*	0.5 *2*				[x]3479.9 *4*	1.0 *2*			

† Additional information 1.

‡ From 1981De38. No ce with E=25-100, no Pm K x ray. Intensities are relative to Iγ(520.9γ)=100. Due to incomplete decay scheme and unplaced γ rays (see comments on the work of 1981De38 above), the absolute intensities cannot be deduced.

From Adopted Gammas. Arguments from this dataset are α(K)exp values given under comments, which are derived from simultaneous measurements of Iγ and ce(K) (1981De38,1973VaYZ).

[x] γ ray not placed in level scheme.

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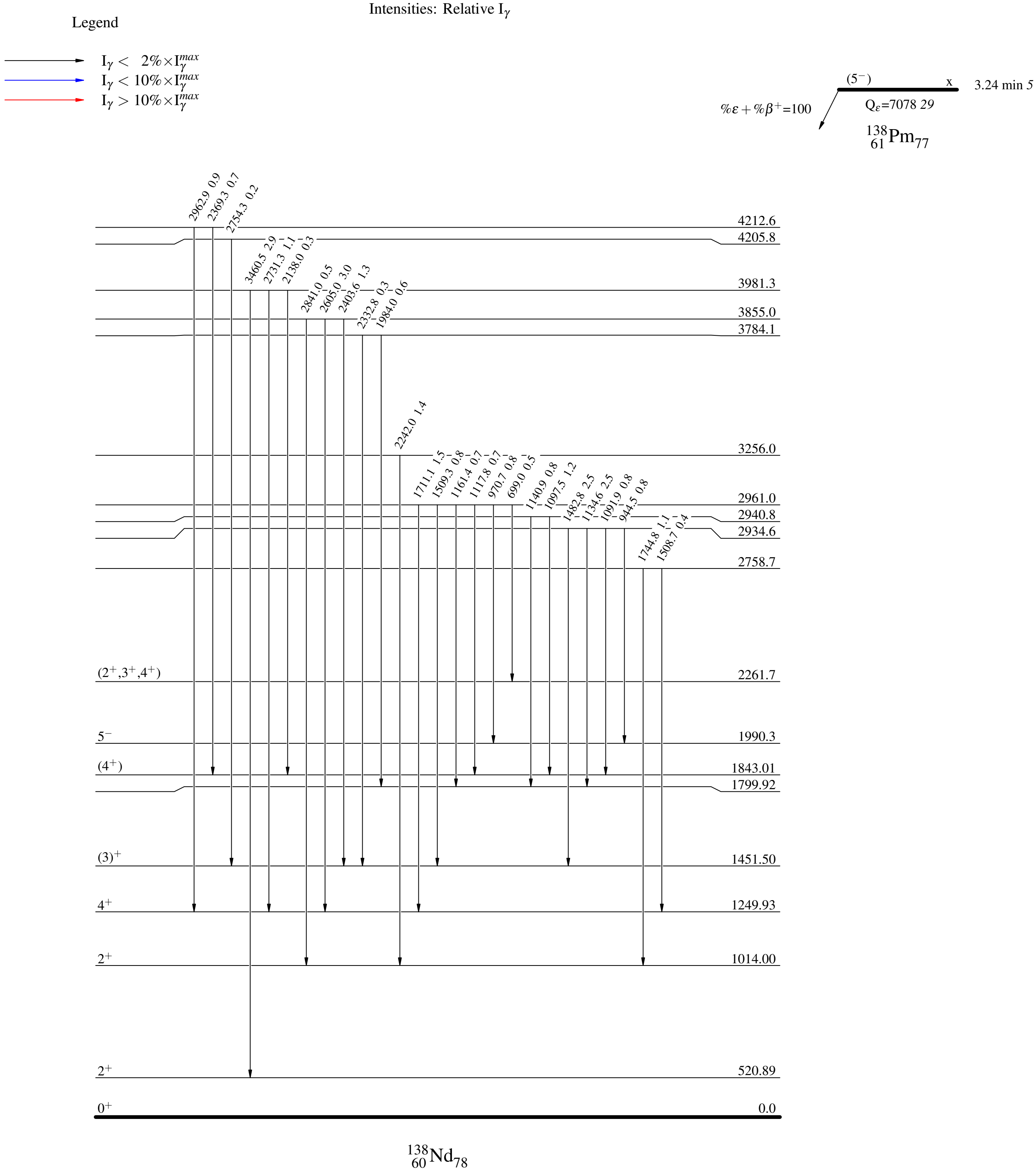
Decay Scheme

Intensities: Relative I_γ



^{138}Pm ε decay (3.24 min) 1981De38

Decay Scheme (continued)